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Plant-Parasitic and Entomogenous Nematode Research

A Directory of Selected USDA and State Projects in CRIS

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PLANT-PARASITIC AND ENTOMOGENOUS NEMATODE RESEARCH

A Directory of Selected USDA and State Projects in CRIS

Prepared by

Current Research Information System
Cooperative State Research Service

and

Information Systems Division
National Agricultural Library

U.S. DEPARTMENT OF AGRICULTURE

May 1991

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CURRENT RESEARCH INFORMATION SYSTEM

The Current Research Information System (CRIS) is a computer-based information storage and retrieval system which documents and provides access to information on publicly supported agricultural, forestry, and food and nutrition research in the United States. CRIS is operated by the Cooperative State Research Service, U.S. Department of Agriculture.

The CRIS database consists of descriptions of research projects conducted or sponsored by the U.S. Department of Agriculture, the State agricultural experiment stations and land-grant institutions, State forestry schools, Tuskegee University, U.S. schools of veterinary medicine, and participants in the competitive research grants program of the Department. Projects on human nutrition research of the Federal agencies are also included in CRIS. These are maintained in the HNRIMS (Human Nutrition Research and Information Management System) subfile of the database.

Approximately 30,000 ongoing and recently completed research projects are documented in CRIS. Some 5,000 new projects and revisions are entered in the system annually. Most projects remain active for 3-5 years and are retained in the file an additional 3-4 years beyond their termination date. Active projects are updated annually with progress reports and citations to the latest publications resulting from the research.

Retrieval of CRIS project information is provided to users worldwide through the publicly accessible CRIS/USDA online file (File 60) on DIALOG, the online retrieval system of DIALOG Information Services, Inc.

FOREWORD

This directory, "Plant-Parasitic and Entomogenous Nematode Research," is designed to be a handy reference for scientists and students interested in these specific areas of nematology. This disciplinary area is a relatively young member of the biological sciences, in view of the founding of its United States professional society--The Society of Nematologists--in 1962. We believe that it is important to document the many comprehensive and diverse nematology research activities not only to serve professionals in the area, but also to emphasize the impressive growth of the science in recent years.

By taking advantage of the U.S. Department of Agriculture's Current Research Information System computerized database, as well as the Department's collaboration with the research network, we began in early 1989 to examine the contents of the database for relevance to the topics selected and to develop a research inventory. User reactions to this directory are welcome; in fact, we will rely on your comments so that any future directory revisions may make this document more useful.

JOHN M. BARNES
COOPERATIVE STATE RESEARCH SERVICE
U.S. DEPARTMENT OF AGRICULTURE
WASHINGTON, DC 20250

PREFACE

This directory is a selected listing of research projects on plant-parasitic and entomogenous nematodes. Included are projects conducted or sponsored by the U.S. Department of Agriculture (USDA), the State agricultural experiment stations and land-grant institutions, U.S. schools and colleges of veterinary medicine, and other cooperating State institutions.

The source for all projects listed in this directory was the Current Research Information System (CRIS), USDA's computer-based documentation and reporting system for publicly supported agricultural and forestry research in the United States. CRIS is operated by the Cooperative State Research Service, USDA.

Projects in this directory were retrieved from the base of projects which resided in the CRIS master file as of February 1989 and include those active as of October 1986 and later. Additional projects were retrieved in April 1990 and are also included in the directory.

Full project abstracts appear in this directory in the main entry section entitled, "Research Project Descriptions." The section is divided into chapters based on commodity classifications used for classifying projects in the CRIS system. In most cases, abstracts appear in chapters that correspond to the most relevant commodity classifications assigned when the projects were submitted for entry in CRIS. Projects assigned more than one commodity classification are repeated in each of the applicable chapters. Repeat entries are identified by an asterisk next to the directory number in the main entry section and in the indexes.

Arrangement of projects within chapters is alphabetical by State or country, followed in order by name of performing institution, department, and principal investigator.

The three indexes provided are the Keyword/Title Index, Investigator Index, and Performing Institution Index. Directory numbers in the indexes are used for locating projects in the main entry section. The two left-most digits correspond to the chapter in which the project is located and the three right-most digits indicate its position within the chapter.

Index terms in the Keyword/Title Index are the keywords originally assigned by CRIS primarily for use in computer retrieval. Project titles have been inserted to provide context.

The Investigator Index is an alphabetical listing of the principal and co-investigators on the projects.

The Performing Institution Index lists the names of the institutions alphabetically by city within the State or country.

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To obtain abstracts of newer projects or for updates of progress and publications on projects listed here, users may directly access the CRIS online file, CRIS/USDA (File 60), on DIALOG, the online retrieval system of DIALOG Information Services, Inc. The CRIS accession number shown opposite the directory number in the main entry section may be used with a TYPE or DISPLAY command on DIALOG to retrieve project information online at the user's terminal. (A recent file change on DIALOG requires the use of the numeral "9" in place of the first "0" in the CRIS accession number shown in the directory when the TYPE or DISPLAY command is used.) Format 7 in the online file carries the narrative summary including the most recent update of progress and publication citations entered on the project. Projects remain on the file for 3-4 years beyond their termination date and are then purged. The file is updated monthly.

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This directory was compiled by Philip L. Dopkowski and F. Allen Moore, Technical Products and Services, CRIS. Edward A. Warnick, Information Systems Division, National Agricultural Library, provided technical assistance. John M. Barnes, Cooperative State Research Service, furnished scientific oversight and support and assisted in editing for technical accuracy and clarity.

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RESEARCH PROJECT DESCRIPTIONS

CM 02 WATER

02.001 CRIS0085802
IMPROVEMENT OF CHEMICAL APPROACHES TO NEMATODE CONTROL FOR ESTABLISHED TREES AND VINES

MCKENRY M V; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4166 Project Type: STATE
Agency ID: SAES Period: 01 NDV 87 to 30 SEP 92

Objectives: Determine the longevity, efficacy and potential for groundwater contamination of several nematicides applied to soils with varying microbial populations.

Approach: Radio-labeled fenamiphos will be used to test various soils and half-lifes determined. Efficacy data will be collected following use of various nematicides in field situations. We will monitor fruit residues, nematode population densities, yield data, and nematicide mobility to groundwater.

Progress: 87/01 to 87/12. Dne goal of our work is an assessment of fenamiphos (Nemacur registered trademark) half-life in soils with differing cropping, fumigation and nematode treatment histories. We have now assayed for fenamiphos and its metabolites 300 days after treatments to one soil with 6 different pesticides use histories. Chemical analyses with HPLC has proven inadequate and the work is being repeated with GLC. A second goal is the identification of nematicidal agents from sources with greatest potential for eventual biodegradation. To this end we have identified that water extracts from several crops greatly deplete dissolved oxygen levels of a soil solution. These oxygen depleted solutions provide 60 to 72 hr of nematode paralysis, in vitro. Extracts from crops such as Tagetes spp., Vicia sativa and Eschscholtzia californica can also cause direct lethal effects to mobile life stages of nematodes. Extracts of these lethal agents have now been applied to field soils via dripper, mister and direct incorporation. Results have been mixed but nematodes were definitely impacted in 11 of 14 field treatments. This new area of study offers growers the potential to protect their crops from nematodes by the growing and proper incorporation of crop residues. Refinement of dosages and timing of application via drip irrigation systems has led to grower acceptance and usage of Nemacur on a large percentage of vineyards in the vineyards of the Coachella Valley.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

02.002 CRIS0095463
TRICKLE IRRIGATION IN HUMID REGIONS

OVERMAN A J; STANLEY C D; CSIZINSZKY A A; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 34203.
Proj. No.: FLA-BRA-02487 Project Type: HATCH
Agency ID: CSRS Period: 12 DEC 84 to 30 SEP 89

Objectives: To determine crop water requirements and optimum crop and water management methods for trickle irrigation in humid regions. To develop basic guidelines and procedures for applying nutrients and pesticides and determine water and chemical distribution patterns in relation to root systems. To develop specific design criteria and procedures for trickle systems in humid regions: a) to evaluate design application rates; b) to evaluate number and location of emitters; c) to characterize the hydraulic principles for proper and efficient system operation; and d) to determine optimum system configuation with regard to cultural and management practices.

Approach: Row crops of vegetables and ornamentals will be grown with drip irrigation systems varying frequency and volume, introducing pesticides and nutrients, evaluating placement of water and potential minimal irrigation levels in both spring and fall growing seasons on sandy soil.

Progress: 87/10 to 88/09. Nemagation: Methyl bromide 98%/chloropicrin 2% (.25 or .5 kg 30 m- row) injected as a dry gas into a biwall tube buried 7 cm deep mid-bed increased a primary mulched tomato (Lycopersicon esculentum Mill cv. Sunny) crop on sandy soil 33 or 58%, respectively, & in a double crop mode where plastic was no longer a complete film, the low rate increased yield 31%. Five genera of nematodes inhabited the soil: 98 days after nemagation populations of Belonolaimus, Tylenchorhynchus, Meloidogyne & Dolichodorus were still not detectable within 30 cm of the tube in rhizosphere of either tomato crop. Trichodorus in treated soil was estimated at 50% of the control in the primary crop & at 300% of the control in the double crop. The effect of N-sources, forms & rates were compared on plant growth, yield & fruit quality of drip irrigated tomatoes grown with the full-bed mulch system. Nitrogen sources & combinations were 80% NO(3) + 20% NH(4) or 25%

ND(3) & 75% NH(4). Nitrogen forms were 100% liquid injected through the trickle tube, 20% pre-plant dry + 80% liquid & 33% pre-plant dry + 67% liquid. Rates were 185, 230 and 275 kg ha- N. No significant differences in plant growth, fruit yield and fruit quality were associated with any of the treatments. Water movement monitored for different application rates in a moist soil profile (EauGallie fine sand) indicated lateral movement from an emitter was limited to 20-25 cm from the emitter when maintaining applied water within the top 25 cm of the profile.

Publications: 87/10 to 88/09

CSIZINSZKY, A.A. and STANLEY, C.O. 1987. Sequential cropping of vegetables with combined seep and drip irrigation. HortScience 22:1052. (Abstr.).

CLARK, G.A., STANLEY, C.D. and SMAJSTRLA, A.G. 1987. Micro-irrigation on mulched bed systems: components, system capacities, and management. IFAS, Univ. of Fla., Bull No. 245.

CSIZINSZKY, A.A., STANLEY, C.D. and DVERMAN, A.J. 1987. Response of two tomato cultivars to irrigation systems, fertilizer sources, and plant spacings for three consecutive seasons. Proc. Soil and Crop Sci. Soc. Fla. 46:1-4.

CSIZINSZKY, A.A. and STANLEY, C.O. 1987. Effect of nitrogen source and plant spacing on cauliflower production with trickle irrigation. Proc. Soil and Crop Sci. Soc. Fla. 46:84-88.

DVERMAN, A.J., CSIZINSZKY, A.A., JONES, J.P. and STANLEY, C.D. 1987. Efficacy of metam sodium applied via drip irrigation on tomato. Proc. Soil and Crop Sci. Soc. Fla. 46:4-7.

DVERMAN, A.J. and HARBAUGH, B.K. 1988. Water use in caladium tuber production. Proc. Fla. State Hort. Soc. (In Press).

OVERMAN, A.J. 1988. Chemigation for a second crop of tomato on micro irrigated sandy soil. ESN 19th International Nematode Symp. Nematologica 34: (In Press). (Abstr.).

02.003 0144052

NEMATODE MANAGEMENT PRACTICES FOR THE SOUTHEAST TO REDUCE GROUNDWATER CONTAMINATION

JDHNSON A W; WAUCHOPE R O; Agricultural Research Service, Tifton, **GEORGIA** 31794.

Proj. No.: 6602-13240-001-000

Project Type: INHOUSE

Agency IO: ARS Period: 20 JAN 89 to 01 JAN 94

Objectives: Oevelop technology to manage root-knot, sting, and other nematodes with reduced chemical application rates and increased efficacy. Determine relationships between nematicide concentrations and nematode population densities, and relationships between nematode population density and damage to root function. Develop a model for nematicide behavior and fate in soil and groundwater.

Approach: Nematode management technology, using laboratory, greenhouse, and field experiments (standard and new techniques) including formulation innovations for nematicides, crop rotations, cultural practices, resistant varieties, cover crops, tillage methods, and nemagation will be developed. Nematode population densities, root-gall indices, crop response, yield and quality will be recorded. A model for nematicide behavior and fate in soils and groundwater will be developed. The model development will be used to define environmental process parameters and chemical properties that control nematicide behavior and efficacy. The research will be conducted in cooperation with agricultural engineers, agronomists, horticulturists, economists, entomologists, plant pathologists, modelers, weed scientists, and soil/water scientists at Tifton, GA; Ft. Collins, CO; Beltsville, MO; Peoria, IL; New Orleans, LA; and other locations.

Progress: 89/01 to 89/12. This is a new project. Groundwater sampling equipment has been designed and installed in field plots to determine the concentrations of nematicides (fenamiphos and others) in surface and groundwater as affected by tillage practices and conventional vs. chemigation pesticide application. A leaching experiment to determine the effects of controlled-release formulations of herbicides and an experimental tank-adjuvant leach-inhibitor on mobility were determined in packed soil columns using both bioassay and residue analysis has been completed. A similar experiment with nematicides using smaller "undisturbed" cores from three different Coastal Plain soil types is in progress. A Research Associate, Dr. Benali Burgoa, soil physicist from the University of Florida, has been recruited and will come on board February 1990. A scenario (data set) for the ARS "RZWQM" water-quality model giving complete weather, soil, crop growth, and pesticide application data is being constructed in cooperation with the UGA Extension Service for cotton grown on a well-characterized watershed at Tifton. This data set will be the first tested on the RZWQM model. Manuscripts reporting on deposition of chlorpyrifos under chemigation, thr persistence of alachlor in the vadose zone, and a review of pesticide solubilities have been submitted for publication.

Publications: 89/01 to 89/12

WAUCHOPE, R.O. 1989. Ag chemicals Environmental fate. Farm Chemicals 152 28.

WAUCHDPE, R.D., WILLIAMS, R.G. and MARTI, L.R. 1989. Runoff of sulfometuron-methyl and cyanazine from small plots. Effects of formulation... J. Environ. Qual. 19. Accepted August 9, 1989.

WAUCHDPE, R.D., WILLIAMS, R.G. and L.R. MARTI. 1989. Runoff of sulfometuron-methyl and cyanazine from small plots under simulated rainfall... Abstr. Weed Sci. Soc. Amer. p. 99.

PDTHULURI, J.V., MDDRMAN, T.B., DBENHUBER, O. and WAUCHDPE, R.D. 1989. Persistence of alachlor in surface soils and groundwater aquifers under anaerobic conditions. Abstr. Weed Sci. Soc. Amer. p. 217.

02.004 0144454

BIOCONTROL OF PLANT PARASITIC NEMATODES TO REDUCE GROUND WATER CONTAMINATION FROM NEMATICIDES

MEYER S L F; HUETTEL R N; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-13240-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 FEB 89 to 01 FEB 94

Objectives: (1) Identify, isolate, and characterize fungi that are antagonistic to the soybean cyst nematode (SCN). (2) Develop SCN-antagonistic fungi for biocontrol of the SCN by enhancing their virulence, fungicide tolerance, and environmental stability. (3) Evaluate effectiveness of SCN-antagonistic fungi to control the SCN.

Approach: Fungi will be tested for antagonism to soybean cyst nematode. Genetically manipulated strains (mutants induced by ultraviolet light or chemicals) will be evaluated in greenhouse and field plots, along with wild type strains, to determine which fungi are effective against soybean cyst nematode in the soil.

Progress: 89/02 to 89/12. A strain of fungus antagonistic to the soybean cyst nematode was evaluated in greenhouse studies for ability to act as a biological control agent against this nematode in the soil. These studies supplied information on optimal application rates of fungal inoculum and on ability of the fungus to act when applied at planting and as a postplant pesticide. Methods for production of fungal inoculum were improved and new procedures were developed to expedite production of alginated pellets containing the fungal matter. Alginated pellets are used to deliver the fungal inoculum to the soil. Pellets up to one year old were found to contain viable fungal inoculum, indicating that this delivery system may prove useful in commercial applications. Strains of fungi that exhibited increased tolerance to the fungicide benomyl were grown without benomyl present and then studied to determine whether the increased benomyl tolerance persisted. Such tolerance may increase the ability of a fungus to act as biocontrol agent when benomyl is applied as part of an integrated pest management system. Two strains of fungi were also tested in the laboratory for antagonism to the root knot nematode Meloidogyne incognita. An "Invention Reporting and Invention Ownership Form" was approved by the Patent Committee for Biotechnology in June 1989. This research is directed toward finding alternatives to chemical nematicides that have contributed to groundwater contamination.

Publications: 89/02 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

06.001 CRIS0081809
USE OF ENTOMOGENOUS NEMATODES (NEOAPLECTANA SPECIES) FOR MAN AND HIS RESOURCES

POINAR G O JR; Entomology & Parasitology; University of California, Berkeley, **CALIFORNIA** 94720.
Proj. No.: CA-B*-ENT-3985-H Project Type: HATCH
Agency IO: CSRS Period: 01 JUL 80 to 30 SEP 87

Objectives: To test N. carpocapsae against the elm bark beetle under greenhouse and field conditions to evaluate it as a biological control agent. To develop a synthetic media for mass reproduction of the nematode in order to obtain large amounts of inocula for field release.

Approach: Infested trees with elm bark beetles will be located in the field and then treated with nematodes. Samples of larvae and pupae will be taken periodically and dissected in order to determine the rate of infection. Emerging adults will be collected and examined for nematodes. In regards to the culture studies, a variety of compounds will be tested in hopes of preparing a monoxenic defined media.

Progress: 80/07 to 87/09. This project resulted in a total of 40 publications over the 7-year period (1980-1987). The program involved searching for isolating and identifying insect parasitic nematodes which then were tested both in the laboratory and field against pest insects. Those nematode strains that showed promise were studied further in regards to their movement, enemies and effect on nontarget hosts. The program was aimed at using nematodes to control insect pests in the soil and thus keep chemical pesticides from entering our ecosystem. New nematodes that were identified include representatives of the genera Neoaplectana, Heterorhabditis, Mermis, Isomermis, Strelkovimermis and Rhabditis. Nematodes from the genera Neoaplectana and Heterorhabditis were used to control pest insects, including the gypsy moth, corn root borer, strawberry root weevil, termites, cabbage root maggot, mosquitoes, and Mediterranean fruit fly. It was discovered that these nematodes are susceptible to certain fungi. Studies also showed how far and fast nematodes could move in the soil, how they could find their hosts with the aid of a temperature gradient and how long they could survive in the soil while searching for insects. Tests to determine the safety of the nematodes showed that while they could attack and kill spiders, pillbugs, millipedes and pseudoscorpions, they did not have any effect on warm-blooded vertebrates.

Publications: 80/07 to 87/09
BAKER, G.L. and POINAR, G.O., JR. 1986. Mermis quirindeansis n. sp. (Nematoda: Mermithidae), a parasite of locusts and grasshoppers in southeastern Australia. Revue Nematol. 9:125-134.
POINAR, G.O., JR. and JANSSON, H.B. Infection of Neoaplectana and Heterorhabditis (Rhabditida: Nematoda) with the predatory fungi, Monacrosporium ellipsosporum and Arthrobotrys oligospora (Moniliales: Deuteromycetes).
POINAR, G.O., JR. 1987. Heterorhabditis megidis sp.n. (Heterorhabditidae Rhabditida) parasites in the Japanese beetle in Ohio. Proc. Hel. Soc. Wash. 54:53-59.

06.002 CRIS0091516
INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

APPLEBY J E; MALEK R B; JOKELA J J; Agri Entomology; University of Illinois, Urbana, **ILLINOIS** 61801.
Proj. No.: ILLU-12-0382 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 83 to 30 SEP 89

Objectives: Determine the influence of abiotic factors on the occurrence and severity of pine wilt disease in conifers; determine the mechanism of pine wilt disease and of resistance, within and among species of conifers; describe the ecology, behavior, and population dynamics of the nematode, its principal insect vectors, and associated fungi; and develop management techniques for reduction of losses from pine wilt disease.

Approach: Disease incidence and development will be correlated with natural and controlled climatic conditions. Roles of the biotic components of the complex will be clarified and their biologies and interactions determined. Provenance plantations will be monitored for resistance and mechanical and chemical means of disease suppression evaluated.

Progress: 86/10 to 87/09. In 1987 pine wilt disease continued to cause high mortality of Scotch pine trees within Illinois. Many of the Scotch pine deaths occur in trees that because of their age and location are extremely valuable for their aesthetic quality. In the Midwest the principal insect vector of the pinewood nematode, the causal agent of the disease, is the Carolina pine sawyer. To date, no effective measures are available for the control of the disease or its insect vector. Investigations were initiated in 1987 in hopes of finding a long-lasting protectant that would kill the beetles and would prevent their transmission of nematodes to healthy pines. On June 1, 1987 at Champaign, IL foliar sprays of dimethoate, carbofuran, bendiocarb, and chlorpryrifos were applied to 6-ft Scotch pine trees. A bioassay test was conducted to determine how long the various chemical sprays would be effective in killing the beetles and therefore preventing the transmission of the nematodes. In the test sprayed branches were removed at weekly intervals and fed to healthy adult sawyers. Results have shown that carbofuran, bendiocarb, and chlorpyrifos gave 100% kill for a period of 3 weeks after the initial treatment, but only chlorpryrifos was effective for 4 weeks. The dimethoate spray application was effective for only 1 week. In previous studies it was found that the average adult life span of the Carolina pine sawyer was about 50 days and that the adult beetle was capable of transmitting nematodes during its entire life span.

Publications: 86/10 to 87/09
MALEK, R.G., SHURTLEFF, M.C., APPLEBY, J.E. and BOUSEMAN, J.K. 1987. Pine wilt disease. Univ. Ill. Coop. Ext. Report No. 1104. 10 pp.

06.003 CRIS0091515
INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

MALEK R B; APPLEBY J E; HIMELICK E B; Plant Pathology; 1301 West Gregory Drive, Urbana, **ILLINOIS** 61801.
Proj. No.: ILLU-68-0382 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 89

Objectives: Determine the influence of abiotic factors on the occurrence and severity of pine wilt disease in conifers; determine the mechanism of pine wilt disease and of resistance, within and among species of conifers; describe the ecology, behavior, and population dynamics of the nematode, its principal insect vectors, and associated fungi; and develop management techniques for reduction of losses from pine wilt disease.

Approach: Disease incidence and development will be correlated with natural and controlled climatic conditions. Roles of the biotic components of the complex will be clarified and their biologies and interactions determined. Provenance plantations will be monitored for resistance and mechanical and chemical means of disease suppression evaluated.

Progress: 86/10 to 87/09. Pine wilt was detected in seven additional Illinois counties (T=74). Incidence of the disease again was substantially greater during the spring period of tree mortality than during the late summer-autumn period. The low late-season disease incidence was related to hot, dry weather during the peak-period of transmission of the causal nematode, Bursaphelenchus xylophilus, by vectors in June, conditions which could disrupt the vector infection/transmission portion of the disease cycle. Incidence of nematode infection of vector beetles emerging from Scotch, red and white pines was markedly lower than in prior years, apparently becuase of weather-induced abnormal desiccation of wood. A fourth species of pine sawyer beetle, Monochamus titillator, was shown to be capable of transmitting B. xylophilus to live Scotch pines; all four species occurring in Illinois now have been demonstrated to be vectors. M. titillator from dead southern Illinois red pines and M. notatus from dead northern Illinois white pines not killed by pine wilt transmitted lethal populations of B. xylophilus to live Scotch pines, further indicating that the general population of the nematode in the State is composed of a single pathogenic race. Branch inoculation of young plantation Scotch pines with the nematode to determine disease incubation period resulted in some partial branch mortality around inoculation sites but no total death of trees by mid autumn.

Publications: 86/10 to 87/09
SIKORA, E.J. 1987. The pine wilt complex: feeding preference of the adult Monochamus carolinensis and influence of temperature on disease development in Scotch pine. M.S. Thesis. University of Illinois, Urbana, 68 p.

06.004 CRIS0091514
INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

FERRIS J M; FERRIS V R; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IND058019-B Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To describe the ecology, behavior and population dynamics of the nematode, its principal insect vectors, and associated fungi.

Approach: To assess differences among geographically separated populations of Bursaphelenchus, isolated nematodes will be increased on selected fungi grown in Petri dishes. These nematodes will be examined and compared by measurements of morphological and other characteristics.

Progress: 86/10 to 87/09. Numerous wood samples from pine, more than in previous years, were submitted to the nematode diagnostic laboratory. Specimens of Bursaphelenchus were obtained from 21% of them. However, none of these were recovered from white pine.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

06.005 CRIS0087378
ENHANCEMENT OF ENTOMOPATHOGENS AFFECTING FOREST INSECT PESTS OF KENTUCKY

NORDIN G L; Entomology; University of Kentucky, Lexington, **KENTUCKY** 40506.
Proj. No.: KY00497
Project Type: MCINTIRE-STENNIS
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: To determine basic biological and ecological characteristics of the principal forest insect-entomopathogen systems. To optimize in vivo production of certain obligate entomopathogens in forest insects by utilizing the juvenile hormone analog, methoprene, to increase the pathogen yield per insect. To investigate novel strategies for enhancing beneficial effects of forest entomo-pathogens by autocidal methods.

Approach: This project has as its primary goal the study of enhancement of entomopathogens for microbial control of forest insect pests. Novel approaches to enhancing the influence of entomopathogens will be addressed with emphasis on autodissemination techniques utilizing Baculovirus. Likewise the basic biology of newly discovered insect pest-pathogen systems and epizootiological events will be studied as encountered. Additionally work on improving in

vivo production of obligate entomopathogens will assure that adequate quantities of pathogen inoculum will be available for small scale field trials.

Progress: 87/01 to 87/09. The following report summarizes the principal activities for project 497. Early phases of this project dealt with basic biology and ecology studies on significant forest insect defoliators including the eastern tent caterpillar, Malacosoma americanum, a noctuid, Phoberia atomaris, the fall webworm, Hyphantria cunea, and the eastern spruce budworm, Choristoneura fumiferana. Discovery of endemic entomopathogens affecting these pests and opportunities for enhancing their impacts were addressed using introduction and augmentation approaches involving transplantation of laboratory-infected individuals into field populations or passive vectoring by parasitoids such as Cotesis hyphantriae. Later, the biologies of various forest insect borers of eastern hardwoods were investigated such as the locust twig borer, Ecdytolopha insiticiana, the locust borer, Megacyllene robiniae, the twolined chestnut borer, Agrilus bilineatus, the carpenterworm, Prionoxystus robiniae, and the cottonwood borer, Plectrodera scalator. Use of entomogenous nematodes and fungi were shown to be particularly appropriate for microbial control of these cryptic species. The nematodes, Steinernema feltiae and S. bibionis, and the entomogenous fungus, Beauveria bassiana, were found to be most useful for suppression of these pests. Interestingly, the soil-applied fungus preparation of Beauveria bassiana, RS-252, was very infectious to cottonwood borer adults habituating treated cottonwood rootstocks for mating and oviposition.

Publications: 87/01 to 87/09

DUNN, J.P. 1985. Attraction of the twolined chestnut borer, Agrilus bilineatus (Weber) and other associated borers to stressed white oak, Quercus alba. M.S. Thesis, Univ. of Kentucky. 113p.

NORDIN, G.L. and O'CANNA, D. 1985. Development threshold temperatures and thermal constants for two types of fall webworm, Hyphantria cunea (Drury) (Lepidoptera: Arctiidae) occurring in central Kentucky. J. Kan. Entomol. Soc. 58:626-630.

DUNN, J.P., KIMMERER, T.W., and NORDIN, G.L. 1986. Attraction of the twolined chestnut borer, Agrilus bilineatus (Weber) (Coleoptera: Buprestidae), and associated borers to volatiles of stressed white oak. Can Ent. 118:503-509.

DUNN, J.P., KIMMERER, T.W. and NORDIN, G.L. 1986. The role of host tree condition in attack of white oaks by the twolined chestnut borer, Agrilus bilineatus (Weber)(Coleoptera: Buprestidae). Oecologia 70:596-600.

THOENY, W.T. 1986. Insects in relation to black locust culture on surface mine spoil in Kentucky, with emphasis on the locust twig borer, Ecytolopha insiticiana Zell. (Lepidoptera: Tortricidae). Ph.D. Thesis. Univ. Kentucky. 175p.

BAUER, L.S. 1987. Pathogenicity of the microsporidian, Nosema fumiferanae (Thom.), in eastern spruce budworm, Choristoneura fumiferana (Clem.)....Ph.D. Thesis. Univ. Kentucky. 130p.

06.006 CRIS0089003

INVESTIGATION OF DISEASES AFFECTING LOUISIANA FOREST TREES

JONES J P; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.

Proj. No.: LAB02304 Project Type: STATE
Agency ID: SAES Period: 01 JAN 83 to 31 DEC 86

Objectives: Determine occurrence and causal organisms of forest tree diseases in Louisiana. Determine disease cycles of forest tree disease in Louisiana. Determine feasible control measures for forest tree diseases in Louisiana.

Approach: Through contacts with foresters from state and federal agencies and private industry, potential disease problems will be identified, causal agents will be isolated and suspeted causal agents tested. Disease cycles will be followed under field conditions and verified by controlled inocultion studies in the greenhouse and laboratory. Various possible control methods will be considered and tested under controlled conditions in the greenhouse as well as under field conditions.

Progress: 82/09 to 86/12. This project is being terminated in order to administratively consolidate it with another project (Hatch 2427). One of the major investigations to be conducted under this project involved a cottonwood defoliation problem. This study had to be terminated when the plantation involved was abandoned for economic reasons. A study of the pine wilt disease indicated that a fungus, Gliocladium virens, was consistently associated with the pine wilt nematode in diseased trees. It was found that the nematode was able to reproduce quickly an the fungus in petri dish culture and in inoculated slash pine seedlings. A study to determine the cause of pine conelet abortion in a Louisiana seed orchard was conducted, with only one known pathogen, Sphaeropsis sapinea, recovered. It was found that a single application of Benlate reduced flower loss by 5%.

Publications: 82/09 to 86/12

MCGAWLEY, E.C., WINCHELL, K.L., JONES, J.P., BIRCHFIELD, W. and BERGGREN, G.T. 1985. Population development and influence of Bursaphelenchus exlophilus on Gliocladium virens. J. Nematology 17:69-76.

HOLCOMB, G.E. and JONES, J.P. 1984. Hosts of the leafspot fungus Tubakia dryin in Louisiana. Plant Disease 68:251.

GOYER, R. and JONES, J.P., Editors. 1985. Insects and diseases in southern forests. Proc. 34th Annual Forestry Symposium. L.S.U. Press, Baton Rouge.

06.007 CRIS0130943
PINEWOOD NEMATODE: A STRESS FACTOR PREDISPOSING PINES TO ATTACK BY BARK BEETLES

KINN D; USDA Forest Service; Southern Forest Expt Station, Pineville, **LOUISIANA** 71360.
Proj. No.: LAR-SO-4500 Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 86 to 31 AUG 88

Objectives: PROJECT 8601563. Document the temporal synchrony of pinewood nematode infection and southern pine beetle spot development. Determine if sublethal pinewood nematode infection can lower host tree resistance to southern pine beetle attack.

Approach: Symptomatic trees will be examined for pinewood nematodes and cultures of the nematode obtained from loblolly pine will be maintained in the laboratory. These nematodes will be mass cultivated and used to inoculate trees in the field. These trees will be observed for symptoms of pine wilt disease and utilization by other axlophilus organisms.

Progress: 87/01 to 87/12. The presence of pinewood nematodes in southern pine beetle (SPB) infestations was sampled at three locations in Louisiana and Texas in order to determine the temporal relationship between the nematode and the SPB attack process. Five loblolly pines from each of four tree condition categories were sampled at four standardized heights on the bole. Condition categories were healthy (no SPB attack but adjacent to the active edge of the beetle infestation), early attacked (current SPB attacks and eggs), late attacked (SPB larvae and pupae), and dead (post SPB emergence). Pinewood nematodes were recovered from 0 of 40 samples from healthy trees, 5 of 40 from early attacked trees, 30 of 52 from late attacked trees, and 33 of 60 from dead trees. A study was initiated to compare oleoresin flow between trees inoculated with 50,000 pinewood nematodes and control trees inoculated with supernatant from the nematode slurry. Twenty-four trees were included in a randomized complete block design. The amount of resin flow over a 24-hour period has been measured 5 times since inoculation on July 13. Differences in resin flow will be analyzed using ANOVA.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

06.008 CRIS0092111
INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL01460 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To determine the influence of abiotic factors on the occurrence and severity of pine wilt disease in conifer.

Approach: Accurate biological monitoring procedures for the detectionof Bursaphelenchus(underlined) xylophilus(underlined) and the pine wilt disease will be developed for use in Michiganforests. The nature and distribution of the pathogen and disease will be evaluated in relation to environmental monitoring data. The resources of the Michigan CooperativeForest Pest Management Program will be used for implementation of the research.

Progress: 87/01 to 87/12. The Michigan State University pinewood nematode research program continues to operate on a very limited basis. Studies on the potential of morantel tartrate for control of Bursaphelenchus xylophilus have been inconclusive. The research will be continued in 1988 and 1989. In 1987, mortality of pine trees due to the pinewilt disease and the pinewood nematode increased significantly. In urban environments, demonstration of optimal water and nutrient levels for trees in high risk sites appear to be providing protection against the pinewilt disease. In 1987, Bursaphelenchus xylophilus was recovered from Jack Pine in Michigan in a forest environment.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

06.009 CRIS0091815
INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

BLANCHETTE R A; FRENCH D W; Plant Pathology; University of Minnesota, St Paul, **MINNESOTA** 55108.
Proj. No.: MIN-22-090 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To determine the mechanism of pine wilt disease and of resistance, within and among species of conifers. To describe the biology, behavior, and population dynamics of the nematode, its principal insect vectors, and associated fungi.

Approach: Isolates of B(underlined). Xylophilus(underlined) from cut timber and dying conifers of pine and balsam fir will be inoculated to seedlings of native and exotic pine seedlings. Cages containing seedlings, cut timber, and branches on field trees will be used to study transmission by cerambycid beetles during oviposition and maturation feeding. Fungus cultures will be reared from the insects most commonly infected with B(underlined). Xylophilus(underlined) and reproduction of the nematodes on fungi will be measured.

Progress: 87/01 to 87/12. Thirteen-year-old Scots pine trees located in southeastern Iowa were inoculated with Bursaphelenchus xylophilus in the main bole of the tree or in branches. Half of the trees were selected at random and destructively sampled 18 weeks after treatment. The remaining trees were harvested 50 weeks after treatment. Eighteen weeks after inoculation, 10 of 20 branch-inoculated and 10 of 20 stem-inoculated trees were dead or dying. Fifty weeks after inoculation, 6 of each of the remaining 10 branch- and stem-inoculated trees were dead or dying. In contrast, the control

trees were symptomless at 18 and 50 weeks after treatment. An average of 224.7 nematodes per g were extracted from samples collected from inoculated branches. The numbers of nematodes and proportions of samples with nematodes declined from 18 to 50 weeks. In addition, B. xylophilus was recovered from stem samples collected from 15 of 20 branch-inoculated trees. An average of 184.7 nematodes per g were recovered from samples collected at 1 m intervals from stem-inoculated trees. Significant differences ($P<0.01$) in the distributions and numbers of nematodes in stem-inoculated trees were detected between trees with or without symptoms. Histological studies of nematode-host interaction are underway to determine the morphological and chemical barriers that restrict nematode movement in nonsusceptible, native pine species vs. exotic pine species.

Publications: 87/01 to 87/12

BEDKER, P.J. 1987. Assessing pathogenicity of the pine wood nematode. pp. 14-25. In. M.J. Wingfield (ed.) Pathogenicity of the Pine Wood Nematode. APS Press, St. Paul. 122 pp.

BEDKER, P.J., WINGFIELD, M.J. and BLANCHETTE, R.A. 1987. Pathogenicity of Bursaphelenchus xylophilus on three species of pine. Can. J. For. Res. 17:51-57.

WINGFIELD, M.J. 1987. Fungi associated with the pine wood nematode, Bursaphelenchus xylophilus, and cerambycid beetles in Wisconsin. Mycologia 79:.

06.010 CRIS0084223

INSECTS ASSOCIATED WITH FOREST AND PLANTATION COMMUNITIES IN MISSOURI

LINIT M J; Entomology; University of Missouri, Columbia, **MISSOURI** 65211.

Proj. No.: MO-00156 Project Type: MCINTIRE-STENNIS
Agency ID: CSRS Period: 01 JUL 86 to 30 JUN 91

Objectives: To study the interspecific association of Monochamus carolinensis and the pinewood nematode. To study the impact of insects on black walnut nut production and oak regeneration.

Approach: Nematode-attractive chemical compounds from M. carolinensis pupal chambers will be identified and bioassayed. The temporal pattern of nematode exit from M. carolinensis and the efficiency of nematode transmission through M. carolinensis feeding wounds and oviposition sites will be studied. Age specific life tables will be constructed to partition insect-induced black walnut nut mortality through the growing season. Asiatic oak weevil emergence patterns will be monitored to determine the spatial and temporal patterns of weevil emergence.

Progress: 87/01 to 87/12. The spatial dispersion of emerging adult Asiatic oak weevils, Cyrtepistomus castaneus, was determined by capturing weevils in ground emergence traps within an oak-hickory forest. Eighty traps were placed 3 m apart in an 8 x 10 grid. All traps were checked three times a week during June and July and twice a week during August and September. The total number of weevils caught per trap was recorded. The observed trap catch frequency was defined by a negative binomial distribution indicating an aggregated spatial dispersion. Significant correlations were found between weevil emergence density and the number of oak stems adjacent to the emergence traps. Insect-induced nut mortality was monitored on 744 black walnuts from 350 clusters on 70 trees in an intensively managed plantation in southern Missouri. Mortality was monitored on 12 May, 22 May, 1 June, 11 June, 22 June, 2 July, and 1 September. A total of 357 nuts aborted prior to maturity. Fifteen nuts aborted following oviposition by the black walnut curculio, Conotrachelus retentus. The majority of mortality occurred between the first and second sampling dates, representing pistillate flower abscission. Most curculio associated nut loss occurred between 1 June and 22 June. Nut survivorship at this plantation was higher in 1987 than during the two previous years, while curculio-associated losses were lower. No. of Graduate Students: 5.

Publications: 87/01 to 87/12

FERGUSON, C.S. 1987. Distribution and host plant preference of the Asiatic oak weevil, Cyrtepistomus castaneus (Roelofs), in a Missouri oak-hickory forest. Ph.D. Dissertation. University of Missouri-Columbia. 125 p.

HUMPHRY, S.J. 1987. Effect of the pinewood nematode, Bursaphelenchus xylophilus (Nematoda: Aphelenchoididae), on flight duration of Monochamus carolinensis (Coleoptera: Cerambycidae). M.S. Thesis. University of Missouri-Columbia. 76 p.

SCHREIBER, A.A. 1987. Impact of insects on nut production in a black walnut plantation. M.S. Thesis. University of Missouri-Columbia. 75 p.

06.011 CRIS0027934

PLANT DISEASE SURVEY AND SPECIAL INVESTIGATIONS

WYSONG D S; WATKINS J E; BOOSALIS M G; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.

Proj. No.: NEB-21-001 Project Type: STATE
Agency ID: SAES Period: 01 JUL 66 to 13 MAR 89

Objectives: Monitor plant disease occurrence; determine casal agents of new diseases; deliniate geographic distribution of new and recurring diseases on a periodic basis; make preliminary studies on severity of new or certain recurring diseases; develop judments on feasibility of short-term versus long-term investigations on certain diseases.

Approach: Conduct periodic field examinations for diseases on field crops with particular attention to alfalfa, corn, sorghum, soybeans and wheat; record and maintain records of pathogen identification, disease severity and location, host, and other pertinent data; conduct further study of specific plant diseases collected on survey; study applicability of practical control measure for

economically important diseases.

Progress: 87/01 to 87/12. SOYBEANS: A soybean cyst nematode (SCN) survey was conducted in an 8-county area bordering the Missouri River between Richardson County on the south and Burt County on the north. A total of 130 soybean fields were included in the survey, which was initiated in late July and completed in mid-August, 1987. Assays of soil and plant roots collected on survey resulted in the identification of 13 "new" infested fields. The number of fields surveyed by county and the number of confirmed SCN fields (in parentheses) is as follows: Richardson - 20 (4), Nemaha - 20 (2), Otoe - 20 (1), Cass 10 (1), Sarpy - 13 (2), Douglas - 7 (1), Washington - 20 (0), and Burt - 20 (2). While all of the infested fields are associated with low-lying, river bottomland soils, four of the fields were located in the central or western sections out of the Missouri floodplain region. Three of these fields were in Richardson and one was in Douglas counties. SORGHUM: A sorghum downy mildew survey was conducted in a 35-county area in south central, east central and southeastern Nebraska in order to determine the incidence and severity of the disease in commercial fields. A minimum of four fields were selected at random in each county. The disease was found to occur in 17 of the 35 counties; it was considered severe and, in a few fields, was felt to be yield-limiting in a four-county area including Nuckolls, Thayer, Fillmore and Clay counties.

Publications: 87/01 to 87/12

POWERS, T. and WYSONG, D.S. 1988. Soybean Cyst Nematode in Nebraska. Crop Prot. Clinic Proc., pgs. 146-148.

JENSEN, S.G., WYSONG, D.S. and DOUPNIK, B., JR. 1988. Sorghum Downy Mildew, The Disease and its Control. Crop Prot. Clinic Proc., pgs. 123-127.

06.012 CRIS0091798

INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11283 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To determine the mechanism of pine wilt disease and resistance, within and among species of conifers.

Approach: Conifers will be inoculated in the greenhouse and field andrelative morality, susceptibility, and pathogenicity determined. Histological sections will be made on inoculated and naturally infected conifers. Vectors will be captured by placing nematode and insect infected logs into cages and as insects emerge, they will be examined andidentified. Nematode populations collected from various sources in the U.S. Will be reared and measured in an attempt to separate pathogenic "strains".

Progress: 87/01 to 87/12. A collection of morphologically similar nematodes tentatively identified as Bursaphelenchus xylophilus from France, the United States, Canada, and Japan are being examined by starch gel electrophoresis. Isozyme comparisons have indicated that the French nematode (F-1) collected from Pinus pinaster and the Canadian nematode (C-2) from Abies balsamae are distinctly different from the other nematodes (US-1, US-7, C-1, and J-6) parasitizing various pine trees. B. mucronatus (J-14) may also be separated by isozyme patterns. Otherwise the geographically separated isolates so far appear to be remarkably similar in detectable isozyme patterns. Of 12 enzymes investigated, just 6 resolve sufficiently to be potentially useful and only 7 of the 30 isolates in the collection have been developed to breed males and females selected as larvae from the various isolates. This research is still in the preliminary stages.

Publications: 87/01 to 87/12

MYERS, R.F. 1987. Pathogenesis in pine wilt caused by pinewood nematode, Bursaphelenchus xylophilus. Journal of Nematology. In press.

06.013 CRIS0091455

INCIDENCE, BIOLOGY AND MANAGEMENT OF THE PINE WILT COMPLEX

RIEDEL R M; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000762 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To determine the influence of abiotic factors on the occurrence and severity of pine wilt disease in conifers.

Approach: One hundred Scots pine (Pinus sylvestris) growing on the Columbus Country Club (Bexley, OH) have been tagged and evaluated for disease and presence of Bursaphelenchus xylophilus. These trees will be cored (1/4 inches x 4 inches) at four places on the trunk (at breast height) once each year in July, for three years. Corings will be examined for B. xylophilus using a modified Baermann funnel technique. Rate of spread of nematodes and the correlation of symptom development with presence of B. xylophilus will be studied for the duration of the study. B. xylophilus is present in Scots pine at the Columbus Country Club and in the surrounding neighborhood. This study will provide data in the rate of spread of B. xylophilus in an urban planting of pine maintained under good conditions of fertility and moisture.

Progress: 83/01 to 86/12. Bursaphelenchus xylophilus was found in 26 Ohio counties, but is assumed to be statewide in distribution. Ninety percent of infested trees were Pinus sylvestris; others were P. resinosa, P. nigra, P. cembra and P. strobus (one case). In a 3-yr period starting from a zero detectable disease base, 65 percent of P. sylvestris on a Columbus, OH golf course become infected with B. xylophilus.

Publications: 83/01 to 86/12
NO PUBLICATIONS REPORTED THIS PERIOD.

06.014 CRIS0137196
SYSTEMATICS, ECOLOGY, AND PATHOGENIC POTENTIAL OF SELECTED PLANT-PARASITIC NEMATODES IN TENNESSEE

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00916 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 89 to 30 SEP 92

Objectives: To identify and describe, when appropriate, plant-parasitic nematodes of potential economic importance, and correlate distribution and abundance of selected nematode species with vegetation and edaphic factors; to determine effects of selected nematode species on host plants.

Approach: Selected crops or plant associations showing stress, or with the potential for being stressed, will be sampled on a field-by-field basis, by plant associations, or by transect. Two major surveys will be conducted: A) on clover pastures and soybean fields to determine the range of a new root-knot nematode species, and B) in all regions of the Great Smoky Mountains National Park, where some species may be contributing to tree declines. Findings will be correlated with edaphic and vegetation factors by means of similarity indices and computer-assisted cluster analysis. Dorylaimid nematodes in the genera Tylencholaimellus and Dorylaimellus will be reared in the greenhouse on corn. Nematodes will be surface-sterilized, then placed on agar plates containing corn callus or excised roots. Nematodes will be observed for feeding and reproduction. An underscribed root-knot nematode parasitic on clover and soybean will be studied to determine host range, pathology on the root system, effects on nodulation, and quantification of damage.

06.015 CRIS0088731
INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

BERGDAHL D R; Forestry; University of Vermont, Burlington, **VERMONT** 05405.
Proj. No.: VTZ00046
Project Type: MCINTIRE-STENNIS
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 89

Objectives: To determine the mechanism of pine wilt diseases and of resistance, within and among species of conifers.

Approach: Laboratory and field methods will be required to study the biology of (Bursaphelenchus(underlined) xylophilus(underlined)) and other organisms associated with pine wilt disease. These methods will include: survey, vector identification, stem analysis, histology, and host predisposition.

Progress: 86/10 to 87/09. Bursaphelenchus xylophilus (pine wood nematode=PWN) has been used to inoculate large trees in the field but to date tree mortality has not resulted. During 1987 (June-September) 140 trees were inoculated at weekly intervals and approximately 60,000 nematodes were inoculated per tree. Chipwood studies continue in an attempt to better understand the population dynamics of the PWN in that wood product. Variability in nematode numbers presents sampling problems. Nematode populations tend to peak at about 3-5 weeks (incubation) and then decline. Various fungi appear to be an important food source. Weevils are being investigated as potential vectors of the PWN in association with wood chips. Fungicicide efficacy and phytotoxicity studies with chlorothalonil and benodanil on balsam fir and blue spruce, respectively, continue at Jericho and Wolcott Research Forests. Frost damage assessment on balsam fir continues following a late spring frost (6/3/86). Two graduate students and 3 work study students were supported between October 1986 and September 1987. The government of Finland is fully supporting one of their graduate students to work on the PWN project at the University of Vermont.

Publications: 86/10 to 87/09
HALIK, S. and BERGDAHL, D.R. Infestation of wounded roots of Pinus strobus by Bursaphelenchus xylophilus from contaminated wood chips mixed in soil. Phytopathology (in press). Accepted for publication 9/15/87.
BERGDAHL, D.R. 1987. Understanding the effects and ecology of fire. Pp. 25-27 in Proceedings Prescribed Fire in New England.
BERGDAHL, D.R. 1987. Impact of Pine Wood Nematode in North America: Present and Future. Journal of Nematology (in press). Accepted for publication 8/10/87.

07.001 CRIS0072312
PARASITIC NEMATODES OF RANGE AND PASTURE: IDENTIFICATION, PATHOGENICITY AND CONTROL

MAGGENTI A R; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-3494-H Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To gain an understanding of the biology and ecology of plant-parasitic nematodes on dry range and irrigated pasture, elucidate the amount of range and pasture plant reduction that can be attributed to nematodes, to determine the role plant-parasitic nematodes play in plant succession, to determine the role of soil evolution on the distribution and pathogenicity of nematodes in undisturbed coastal rangelands.

Approach: Survey major California range and pasture areas for plant-parasitic nematodes, collect soil and plants from the five terraces (ea. 100,000 years old) of the geologic staircase at Jughandle State Park, Mendocino County and correlate soil and plant samples with kinds of nematodes recovered.

Progress: 87/01 to 87/12. Four papers concerning nematodes found in California range and pasture land have been published in refereed journals. Two of these were on nematodes living on Bulrush under aquatic conditions. One is on the subject of the development of rootknot. The fourth study is directed to Anguina amsinckiae that is being studied as a potential biological control agent of Amsinckia spp. (fiddleneck) in the southern coast ranges of California. In addition to these papers published, there are two papers accepted for publication on two new species of Gracilacus; one on coastal redwood trees, and the other from spodosolic soil with a pH of 3.8; the host plant was Juneus enifolius (Pursh). The identification of the plant-parasitic and free-living nematodes of the coastal low pH spodosolic soils continues. Two plant-parasitic nematodes have been discovered living in roots of Bulrush (Scirpus robustus) growing in a freshwater coastal stream. Finding Hirschmanniella under such conditions was not unexpected; finding Meloidogyne (rootknot nematode) was. It seems that rootknot nematode attacks when the water is low and then can survive by being protected by the root tissue. Common fiddleneck (Amsinckia intermedia) is a winter annual weed widespread in small grains, alfalfa, pastures and rangelands. Economic concern stems from the fact that is sufficient quantities it can cause liver damage to range animals. A nematode, Anguina amsinckiae attacks the seed heads of fiddleneck thus reducing seed production.

Publications: 87/01 to 87/12

ABDEL-RAHMAN, F. and MAGGENTI, A.R. 1987. Hirschmanniella pomponiensis n. sp. (Nemata: Pratylenchidae), parasitic on Bulrush, Scirpus robustus Pursh. J. Nematol. 19:147-151.

ABDEL-RAHMAN, F. and MAGGENTI, A.R. 1987. Meloidogyne californiensis n. sp. (Nemata: Meloidogyninae), parasitic on Bulrush, Scirpus robustus Pursh. J. Nematol. 19:207-217.

ABDEL-RAHMAN, F. and MAGGENTI, A.R. 1987. Embryonic and postembryonic development of Meloidogyne californiensis Abdel-Rahman & Maggenti, 1987. J. Nematol. 19:505-508.

PANTONE, D.J., GRIESBACH, J.A. and MAGGENTI, A.R. 1987. Morphometric analysis of Anguina amsinckiae from three host species. J. Nematol. 19:158-163.

07.002 CRIS0140426
ARTHROPODS & PLANT PATHOGENS AS BIOLOGICAL AGENTS TO CONTROL SPURGE, YELLOW STARTHISTLE, & KNAPWEEDS

ANDRES L A; TURNER C E; JURD L; Natural Products Chemistry Research Unit; Western Regional Res Center, Albany, **CALIFORNIA** 94710.
Proj. No.: 5325-24000-003-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Improved comprehension of the relationship between weeds, their environmentand their natural enemies and the use of this information towards improved management of leafy spurge, yellow starthistle , knapweeds and other introduced weeds on range, pasture and crop areas.

Approach: Discover, study, implement and evaluate new and indigenous natural enemies of those weeds naturalized to N. America. Discovery will be via literatureand museum records and field surveys. Studies will include tests and observations on the biology and behavior of candidate agents in foreign anddomestic laboratory, quarantine and field areas to determine each organism's host specialization, adaptability and potential safe use for weed control in N. America. Those found safe to be introduced to the U.S. will be colonized and distributed to weedy areas and their impact evaluatedBasic studies will be carried out on how insects and plant pathogens find, damage and stress their host plants. Host selection behavior studies and tdhe the fixity of the natural enemy host relationship will be carried out with weeds as well as on economic and non-economic non-target plants. Weeds to be investigated include leafy spurge, yellow starthistle, and knapweeds.

Progress: 87/01 to 87/12. Knapweeds: Releases of the root feeding moths, Agapeta zoegana and Pterolonche inspersa ex Austria/Hungary were made against diffuse and spotted knapweeds in OR, WA. A. zoegana from USSR was released in WA. The nematode, Subanquina picridis, (against Russian knapweed) formed galls on most Centaurea spp. tested, some on artichoke and none on safflower. Field bindweed: First US release of the moth, Tyta luctosa in OK and TX. The eriophyid, Aceria convolvuli, was cleared for US release. Yellow starthistle: The seed weevil, Bangasternus orientalis is established in CA and ID. New releases made in CA, OR and WA. The seed fly, Chaetorellia hexachaeta, failed to survive on safflower or cornflower in lab tests. Leafy spurge: First US release of root beetle, Aphthona czwalinae in MT. The tip gall midge,

Bayeria capitigena and the beetle, Aphthona flava are established in MT and ND. US release made of large numbers A. flava, cyparissias and czwalinae. Survey of spurge in China revealed organisms of high biological control potential. Musk thistle: Overall 50% annual reduction of seed CA by the seed weevil, Rhinocyllus conicus.

Publications: 87/01 to 87/12

PEMBERTON, R.W. and G. JOHNSON. 1987. Aphthona cyparissiae (Coleop: Chrysomelidae) a new flea beetle for leafy spurge control in the U.S. Proc. of the 1986 Leafy Spurge Annual Meeting, July, Riverton, WY, pp. 42-48.

PEMBERTON, R.W. 1988. Myrmecochory in the introduced rangeweed leafy spurge. Amer. Midland Naturalist. (In press July, 1987).

TURNER, C.E., R.W. PEMBERTON & S.S. ROSENTHAL. 1987. Host utilization of native Cirsium thistles (Asteraceae) of the introduced weevil Rhinocyllus conicus (Coleoptera: Curculionidae) in CA. Environ. Entomol. 16:111-115.

TURNER, C.E., R.W. PEMBERTON & S.S. ROSENTHAL. 1987. Host range and new host records for the plume moth Playtptilia carduidactyla (Lepidoptera: Pterophorida from CA thistles (Asteraceae) Proc. Entomol. Soc. Wash. 89:132-1326.

ROSENTHAL, S.S., S.L. CLEMENT, N. HOSTETTLER, & T. MIMMOCCHI. 1988. Biology of Tyta luctuosa (Lep.: Noctuidae) and its potential value as a biological control agent for the weed Convolvulus arvensis. Entomophaga 33: In Press.

07.003 CRIS0096490
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

OVERMAN A J; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 33508.
Proj. No.: FLA-BRA-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: Investigation of the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops grown in Florida and evaluation of management strategies designed to reduce economic losses due to nematodes attacking agronomic crops.

Approach: In minimum tilled or tilled field plots, nematode populations will be evaluated on various crop sequencing tests. Nematicides and soil-fumigants will be used to determine effect of nematodes and/or soil-borne diseases on crop production potential.

Progress: 87/10 to 88/09. A RCB design of 52 6m x 9.9 m-plots were established in a 10 year Bahia grass pasture in December 1987. Factors tested in the split plot design over a period of 3 years will be fertilizer (336 kg ha-), nematicide carbofuran (2.24 kgai ha-) and seeding of white clover (4.5 kg/ha) cvs. Osceola + Las-1 in all combinations with controls. All treatments were established in December. Furadan was applied only once. Nematode population estimates made during 12 months following treatment indicate that Hemicycliophora is the most abundant genus in the soil followed by Dolichodorus. In general, no striking nematode differences have occurred due to use of carbofuran.

Publications: 87/10 to 88/09

MISLEVY, P., et al. 1988. 'Florona' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

MISLEVY, P., et al. 1988. 'Florico' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

07.004 CRIS0092702
ECOLOGY, PATHOLOGY, AND CONTROL OF NEMATODES ON CULTIVATED AND NATIVE GRASSES

TODD T C; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00508 Project Type: STATE
Agency ID: SAES Period: 01 JUL 84 to 30 JUN 87

Objectives: To identify phytophagous nematodes associated with cultivated and native grasses. To study pathogenic potential and yield losses due to nematodes. To evaluate control procedures. To investigate nematode interactions with other factors. To determine the importance of nematodes in native prairie grass ecosystems.

Approach: Soil samples will be collected and the nematodes extracted, identified, and counted. Pathogenicity studies will be conducted in the greenhouse and nematicide plots will be established in the field. In vitro interaction studies will be initiated. Nematode trophic levels will be monitored on selected sites of native tall-grass prairie.

Progress: 83/07 to 87/06. Nematodes identified as having an economic impact on grasses in Kansas include an undescribed species of Belonolaimus (close to B. nortoni) and Pratylenchus scribneri on corn, Tylenchorhynchus martini on sorghum, and Hoplolaimus galeatus galeatus on bentgrass. The estimated damage potential of Belonolaimus sp. was 1-3% of seed-corn weight/nematode. A midsummer soil density of approximately 300 H. galeatus/100 cm was determined to approach the threshold level for visual turf damage. Nematicide efficacy was evaluated in multi-year field tests for selected nematode-host systems. Consistent control of corn nematodes was achieved with at-planting applications of carbofuran and Terbufos at 1.1-2.2 kg/ha. Broadcast application of fenamiphos at 4.6 lb/1000 sq ft reduced populations of turf nematodes and improved turf quality. Observations on the interaction of nematodes and other soil fauna in below ground processes were collected from several tallgrass prairie sites. Nematicide-induced reductions in soil populations of free-living nematodes resulted in a 15% increase in dead roots, presumably due to disturbance of decomposition processes. Primary production of the tallgrass prairie was not affected by changes in nematode densities. In a study using mowing regimes to simulate grazing intensities, a decrease in the

percentage of live roots due to mowing was correlated with a decrease in numbers of obligate plant-feeding nematodes and an increase in numbers of bacteria-feeding nematodes.

Publications: 83/07 to 87/06

SEASTEDT, T.R., TODD, T.C., and JAMES, S.W. 1987. Experimental manipulations of arthropod, nematode, and earthworm communities in a North American tallgrass prairie. Pedobiologia 30:9-17.

07.005 CRIS0143120

BIOLOGY AND CONTROL OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH FIELD, FORAGE, AND RANGELAND PLANTS

GRIFFIN G D; Agricultural Research Service, Logan, **UTAH** 84322.
Proj. No.: 5428-24000-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 04 AUG 88 to 03 AUG 93

Objectives: Determine the biological relationship between plant parasitic nematodes andfield, forage, and rangeland vegetation. Determine the ecological and environmental impact of soil-borne organisms on the host-parasite relation-ship between nematodes and plants. Determine the importance of cultural practices, soil types, and control methodologies on nematode population dynamics and host-parasite associations. Develop pest management procedures that will reduce crop/environmental losses caused by nematodes.

Approach: Determine species and population dynamics of plant parasitic nematodes associated with the growth and development of forage, rangeland vegetation,grains, and other field crops under natural and artificial conditions with macro and microstudies. Measure crop losses in relation to nematode-environmental relationships and qualitative-quantitative analyses. Evaluatenematode control methodologies to determine most efficaciouss method(s) with minimal effect on envionmental impact and ecosystem balance. Measure importance of interactions between nematode and pathogenic and beneficial microbes on the growth of plant cultivars using proven and newly developed techniques and methodologies.

07.006 CRIS0049759

BIOLOGY AND CONTROL OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH FIELD, FORAGE AND RANGELAND PLANTS

GRIFFIN G D; Agricultural Research Service; Agricultural Research Service, Logan, **UTAH** 84322.
Proj. No.: 5428-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 84 to 30 SEP 88

Objectives: Determine namatode species associated with field, forage & rangeland vegetation. Determine host-nematode relationship on field, forage & rangeland plants. Determine importance of environment, associated soil borne organisms, soil types, cultural practices, & control of methodologies (resistance, tolerance, biological, physical & chemical) on nematode population dynamics & host/parasite relationships. Develop IPM technologiesthat will reduce and control nematode numbers & nematode related diseases.

Approach: Measure crop losses in relation to namatode population thresholds, nematode-environmental relationships, and qualitative-quantitative analyses. Evaluate nematode control methodologies to determine most efficacious method(s) with minimal effect on environmental impact and ecosystem balance; study nematode biology and host/parasite relationships with macro and microstudies involving manipulation of nematode populations,intrinsic and extrinsic factors, and varying cultural practices. Measure importance of interactions between nematode, and pathogenic and beneficial microbes on forage, field, and range plants under different environmental conditions.

Progress: 87/01 to 87/12. Nematode resistant alfalfa, Nevada Synthetic XX, differed in its response and degree of resistance to Meloidogyne hapla populations from California, Utah, Washington, and Wyoming, and was 100% susceptible to one California population; Ranger alfalfa was 100% susceptible to all populations. Species of Astragalus, Coronilla, Hedysarum, Lathyrus, Lotus, Medicago, Melilotus, Onobrychis, Trifolium, and Vicia differed in susceptibility and nitrogen fixation to Meloidogyne hapla and M. chitwoodi populations. Population densities of Merlinius brevidens, Quinisulcius acutoides, and Pratylenchus neglectus are greater under continuous no-till and chemical fallow no-till regimentations than other conventional fallow cultivation of wheat. The susceptibility of resistant Apollo II and Nevada Synthetic XX, and susceptible Ranger alfalfas to combined inoculations of M. hapla and Phytophthora megasperma f. sp. medicaginis was greatest at 28 C. There was a direct relationship between M. hapla and M. chitwoodi population densities and the growth of Lahontan alfalfa, Hycrest wheatgrass, and Russian wildrye in a competitive plant study; increased nematode population densities reduced plant growth of both resistant and susceptible plants.

Publications: 87/01 to 87/12

GRIFFIN, G.D. 1987. The importance of environmental factors and cultural practices on parasitism of alfalfa by Ditylenchus dipsaci. J. Nematol. 19: 267-276.

GRIFFIN, G.D. 1987. The interaction of Ditylenchus dipsaci and Meloidogyne hapla on susceptible and resistant plants. J. Nematol. 19:441-446.

GRIFFIN, G.D. 1987. Efficacy of using split and post-plant applications of aldicarb to control Heterodera schachtii on sugarbeet. Ann. Applied Nematol. 1:119-122.

GRIFFIN, G.D. 1987. Nonvolatile nematicide control of Heterodera schachtii on sugarbeet. J. Am. Soc. Sugarbeet Tech. Accepted July 20, 1987.

EISENBACK, J.D., and GRIFFIN, G.D. 1987. Interactions with other nematodes. pp. 313-320. In: VEECH, J.A. and DICKSON, D.W. (eds.) Vistas on Nematology. Hyattsville, MD, Society of Nematologists, Inc.

GRIFFIN, G.D., and THYR, B.C. Interaction of Meloidogyne hapla and Fusarium oxysporum f. sp. medicaginis on alfalfa. Phytopathology. Accepted Oct. 6, 1987.

GRIFFIN, G.D. Factors affecting t he biology and pathogenicity of Heterodera schachtii on sugarbeet. J. Nematol. Accepted May 26, 1987.

09.001* CRIS0085802
IMPROVEMENT OF CHEMICAL APPROACHES TO NEMATODE CONTROL FOR ESTABLISHED TREES AND VINES

MCKENRY M V; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4166 Project Type: STATE
Agency ID: SAES Period: 01 NOV 87 to 30 SEP 92

Objectives: Determine the longevity, efficacy and potential for groundwater contamination of several nematicides applied to soils with varying microbial populations.

Approach: Radio-labeled fenamiphos will be used to test various soils and half-lifes determined. Efficacy data will be collected following use of various nematicides in field situations. We will monitor fruit residues, nematode population densities, yield data, and nematicide mobility to groundwater.

Progress: 87/01 to 87/12. One goal of our work is an assessment of fenamiphos (Nemacur registered trademark) half-life in soils with differing cropping, fumigation and nematode treatment histories. We have now assayed for fenamiphos and its metabolites 300 days after treatments to one soil with 6 different pesticides use histories. Chemical analyses with HPLC has proven inadequate and the work is being repeated with GLC. A second goal is the identification of nematicidal agents from sources with greatest potential for eventual biodegradation. To this end we have identified that water extracts from several crops greatly deplete dissolved oxygen levels of a soil solution. These oxygen depleted solutions provide 60 to 72 hr of nematode paralysis, in vitro. Extracts from crops such as Tagetes spp., Vicia sativa and Eschscholtzia californica can also cause direct lethal effects to mobile life stages of nematodes. Extracts of these lethal agents have now been applied to field soils via dripper, mister and direct incorporation. Results have been mixed but nematodes were definitely impacted in 11 of 14 field treatments. This new area of study offers growers the potential to protect their crops from nematodes by the growing and proper incorporation of crop residues. Refinement of dosages and timing of application via drip irrigation systems has led to grower acceptance and usage of Nemacur on a large percentage of vineyards in the vineyards of the Coachella Valley.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

09.002 CRIS0057795
DETECTION, BIOLOGY & CONTROL OF NEMATODES INCITING DISEASES OF AVOCADO, CITRUS, ORNAMENTALS & TURF

VAN GUNDY S D; RADEWALD J D; BALDWIN J G; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-2708 Project Type: STATE
Agency ID: SAES Period: 01 JUN 84 to 30 SEP 89

Objectives: To detect and to determine pathogenicity and biology of various nematodes associated with ornamentals, turf, citrus and avocado. To seek means of control of pathogenic nematodes on these crops through the most efficient usage of new and established nematicides or cultural practices. To evaluate potential varieties or rootstocks for nematode resistance. To provide research on CDFA quarantine and nursery registration programs.

Approach: Survey problem areas of ornamentals, turf, citrus and avocado and determine if nematode pests are involved. If nematodes are suspect as a causal agent of the disease, determine if they are pathogenic and develop economical and reliable means of control through biological cultural means, resistant varieties, or chemicals. Target pests will be studied in isolated quarantine facilities.

Progress: 87/01 to 87/12. Postplant studies conducted with drip irrigation systems for citrus nematode demonstrated two materials, Nemacur and CY81 provided an economic level of control. Additionally, GY81 provided a degree of control of Phytophthora that warrants further investigation. A label change for Nemacur, lessening the time between treatment and harvest (30 days instead of 180 days) along with Nemacur's performance, in all likelihood will make this product a strong candidate for grower useage. Work on morphologic variation and taxonomy of Punctodera in Mexico, Canada, and the U.S. has included investigation of populations apparently pathogeneic on golf greens in the San Francisco area. In addition, we continue investigation of physiologic variation of Radopholus species, including serious pests of citrus and many ornamentals. Recent studies indicate physiologic homogeneity of this nematode in Mexico and confirm that populations in Mexico are not a pathogens to citrus. Ecology studies on the citrus nematode suggest that larvae and males are not active at all times in irrigated groves. The citrus nematode has weak anhydrobiotic survival strategies when confronted with water stress. Studies on parasitism and carbohydrate partitioning are continuing as are studies for resistance to the citrus nematode in new citrus crosses with citrus relatives. An artificial feeding system is being developed for Hemicycliophora arenaria.

Publications: 87/01 to 87/12
MUNDO-OCAMPO, M. and BALDWIN, J.G. Physiological homogeneity of the burrowing nematode in Mexico. J. Nematol. 19:545. Abstr.

09.003 CRIS0141452
BIOREGULATION OF INSECT-PLANT INTERACTIONS

MAYER R T; SCHROEDER W J; SHAPIRO J P; Agricultural Research Service, Orlando, **FLORIDA** 32804.
Proj. No.: 6617-24000-004-00D
Project Type: INHOUSE
Agency ID: ARS Period: 28 MAY 86 to 27 MAY 91

Objectives: Determine effect of plant products on insect reproduction, feeding, digestion, hormones, and chitin metabolism. Characterize vector relationships and phytoalexins in resistant plants. Identify and characterize biological control agents for insect pests, and develop control systems for their application.

Approach: Involves use of diverse techniques including methods in histology, electrophoresis, spectroscopy, fluorimetry and bioassay and immunoassay (ELISA, RIA, SSEM, fluorescent antibody), microscopy (TEM, SEM, LM), probes(dsRNA, antibody, fluorescent, and cDNA), centrifugation, chromatography (affinity, TLC, gel, HPLC), microscopy, isotopes, hemagglutination, and hybridomas.

Progress: 87/01 to 87/12. A bioassay was developed using Mexican lime leaves on an agar media in petri dishes that allows assessment of virulence of Verticillium sp. against citrus aphids; the assay is facile and provides a more rapid method for determination of fungal biocontrol agents to control citrus aphids. Use of a nematode (Steinernema feltiae) isolated from infected larvae of Diaprepes abbreviatus coupled with a new method to increase the efficacy of the entomogenous nematode was shown to reduce citrus root weevil populations to economic threshold levels not previously attainable. These methods will be of interest to all biocontrol programs that utilize nematodes as the biocontrol agents and to the citrus industries in Florida and the Caribbean Basin. Spectrofluorometric studies showed that natural and synthetic xenobiotics (coumarins) are absorbed by hemolymph proteins after ingestion. A model system was subsequently developed to observe binding to hemolymph proteins in vivo and in vitro and to determine if it is possible to alter the dynamics of binding and absorption such that a control method can be developed. An in vitro, cell-free assay for chitin synthase has been developed utilizing gut tissue from D. abbreviatus larvae; this method will allow for testing of chitin synthesis inhibitors against the citrus root weevil and for investigations on the chitin metabolic pathway in this insect.

Publications: 87/01 to 87/12

SCHROEDER, W.J. 1987. Laboratory bioassays and field trials of entomogenous nematodes for control of Diaprepes abbreviatus (Coleoptera: curculionidae) in citrus. Environ. Entomol. 16:987-989.

SCHROEDER, W.J. and BEAVERS, J.B. 1987. Movement of the entomogenous nematodes of the families heterorhabditidae and steinernematidae in soil. J. Nematol. 19(2):257-259.

SCHROEDER, W.J. 1987. Induced pupation in Diaprepes abbreviatus (Coleoptera: curculionidae). Fla. Entomol. 70(1):186-187.

SHAPIRO, J.P. 1988. Isolation and fluorescence studies on a lipophorin from the weevil Diaprepes abbreviatus. Arch. Insect Biochem. Physiol. (Accepted December 1987).

CHEN, A.C., KIM, H.R., MAYER, R.T. and NORMAN, J.O. 1987. Vitellogenesis in the stable fly, Stomoxys calcitrans. Comp. Biochem. Physiol., 88B(3):897-903.

MAYER, R.T. et al. Evidence that chitin synthesis inhibitors affect cell membrane transport. Proc. Intern. Conf. on Endocrinological Frontiers in Physiological Insect Ecology. (Accepted September 1987).

SHAPIRO, J.P., LAW, J.H. and WELLS, M.A. 1988. Lipid transport in insects. Annu. Rev. Entomol. 33:297-318.

09.004 CRIS0141479

INFLUENCE OF SOIL, SOIL MICROFLORA, AND HOST ON SOILBORNE AND BLIGHT DISEASE OF CITRUS

NEMEC S; WUTSCHER H K; HUTCHISON D J; Agricultural Research Service, Orlando, **FLORIDA** 32804.

Proj. No.: 6617-24000-003-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 31 MAR 91

Objectives: Define cause of blight, and improve diagnosis and control. Define rhizo- sphere factors affecting root health and pathogen survival. Define host- pathogen interaction factors affecting disease resistance and improve germ-plasm screening. Develop control systems for soilborne diseases.

Approach: Test transmission of blight by transplanting and root grafting, correlate soil factors with blight incidence, and test amendments to suppress disease. Identify physiological changes causing Zn accumulation and eval- uate as diagnostic markers. Beneficial microflora populations will be compared in rhizosphere and nonrhizosphere areas and augmented by amend- ments. Resistance to pathogen infection will be correlated to physical factors and/or phytoalexins or other pathogen-inhibitory compounds. Quanti-tative tests for phytophthora resistance and preclinical tests for blight will be developed to improve germplasm evaluation. Experimental integratednursery management program will be developed and tested.

Progress: 87/01 to 87/12. Culture techniques for the burrowing nemtode (BN) were modified to increase production efficiency by 400%. Amphidial exudates from plant-parasitic nematodes are rich in glycoconjugates. Sialic acids impaired the reproduction of Meloidogyne spp. in soybean roots, thus suggesting modification of carbohydrates on nematode surfaces may provide a new approach for control. Improved P nutrition associated with mycorrhizal infection reduced BN reproduction in citrus. Seven rootstocks were determined to possess blight tolerance under field conditions. Several produced fruit with excellent juice color. Trees with citrus blight which were growing in slag-treated soil absorbed more water than trees growing in nontreated soil. Fe, Mn, Zn, and Cu injections into soil increased leaf content of these elements in blight-affected trees and tree appearance improved; however, water flow in the trunk remained impaired. Soil pH is higher under blighted than under healthy trees. Water uptake was correlated with wood Zn and pH in blight trees. Comparable enhancement of

seedling growth by the mycorrhizal fungus, Glomus intraradices (GI) was attained with only 0.7% of a broadcast rate for field inoculation when GI was applied to the planting furrow. This greatly reduces the amount of GI inoculum needed to enhance growth of citrus trees.

Publications: 87/01 to 87/12

- SMITH, G.S. and KAPLAN, D.T. Influence of the mycorrhizal fungus, Glomus intraradices, and phosphorus on growth of rough lemon seedlings and burrowing nematode root-population densities. J. Nematol., (Accepted 02/87) (Abstract).
- KAPLAN, D.T. and KOEVENIG, J.L. Description of the host-parasite relationship of Meloidogyne christiei with Quercus laevis. Revue Nematol., (Accepted October 1987).
- KAPLAN, D.T. and DAVIS, E.L. 1987. Mechanisms of plant incompatibility with nematodes. In: Veech, J.A. and Dickson, D.W. (eds.), Vistas on Nematology. Soc. of Nematol., Hyattsville, MD.
- WUTSCHER, H.K. Citrus blight: a horticultural perspective. Proc. Intern. Symp. on Citrus Canker and Declinio/Blight. Sao Paulo, Brazil, (Accepted June 1987) A Portuguese translation is being published in TRUTH (popular pub.).
- WUTSCHER, H.K. 1987. Book Review: Fresh citrus fruits. W.F. Wardowsky, S. Nagy and W. Grierson (eds.), AVI Publishing Co., Westport, CT. HortScience 22:520.
- MICHELINI, S. and NEMEC, S. Effects of vesicular-arbuscular mycorrhizal fungus inoculation on sour orange seedlings in a Barbados seedbed. Puerto Rico J. Agric., (Accepted 8/18/87).
- NEMEC, S., BAKER, R.A. and TATUM, J.H. Toxicity of dihydrofusarubin and isomarticin from Fusarium solani to citrus seedlings. Soil Biol. and Biochem., (Accepted 11/30/87).

09.005 CRIS0143085

MANAGEMENT OF ROOT-FEEDING WEEVILS AND WHITE GRUBS OF CITRUS/SUGARCANE WITH ENTOMOGENOUS NEMATODES

SCHROEDER W J; SOSA O; Agricultural Research Service, Orlando, **FLORIDA** 32804.
Proj. No.: 0500-21010-001-76D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 88 to 30 SEP 91

Objectives: Use entomogenous nematodes to manage soil insects under field conditions. Maximize nematode efficacy through timing of application and release rate. Assess impact of entomogenous nematodes on citrus/sugarcane soil insects. Develop application techniques that can be utilized by industry. Establishindustry cost benefit data. Implement control practices.

Approach: Survey citrus/sugarcane to identify insect-infested fields. Sample soils for presence of endemic entomogenous nematodes. Treat candidate groves and sugarcane fields with an inundative release of entomogenous nematodes. Sample treated groves and fields for nematode population presence. Determine impact of nematode populations on crop yield by comparison of treated and control plots.

09.006 CRIS0099778

CULTURE AND BIOLOGY OF RED RING NEMATODE AND EVALUATION OF HOST-PALM RESISTANCE

GIBLIN-DAVIS R M; Agr Res Cntr; University of Florida, Ft Lauderdale, **FLORIDA** 33314.
Proj. No.: FLA-FTL-02581
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 86 to 30 JUN 88

Objectives: To develop monoxenic and axenic in vitro culture methodologies, examine the developmental biology, and compare the morphology of different geographical isolates of the Red Ring nematode. To develop a bioassy for screening Red Ring resistance in different varieties of the coconut palm: To determine the vector potential of Rhynchophorus cruentatus for carrying the Red Ring nematode in Florida.

Approach: Studies concerning the Red Ring nematode will be centered in Trinidad. In Vitro culture of the nematode will be attempted using monoxenic cultures of two species of fungi, differentiated and non-differentiated palm callus, alfalfa callus, or undefined axenic media. The developmental biology will be examined and the morphometrics of different geographical isolates will be compared in vitro. A Red Ring resistance bioassay will be tested using callus, or 1 yr. old palm seedlings. The weevil, R. cruentatus, will be captured and cultured in Florida and taken to Trinidad for tests on Red Ring vector potential.

Progress: 87/10 to 88/10. One field study and two experiments in Florida confirmed that palms (e.g. Sabal palmetto) must be stressed for successful infestation by the weevil, R. cruentatus. Five pesticides were tested for the prophylactic control of adult R. cruentatus. A laboratory culture method was developed for rearing R. cruentatus and R. palmarum using sugarcane or pineapple and sugarcane at 28 C. Longevity of newly-emerged R. cruentatus ranged between 40-113 days for females and between and between 5-150 days for males confined to fresh pineapple slices. Fecundity of R. cruentatus was 26 +/- 15 eggs per female per lifetime over a 42 +/- 19 ovipositional period when confined on fresh pineapple slices. Monoxenic culture of the red ring nematode (RRN) was not successful on the fungi, Monilinia fructicola or Botrytis cinerea, or on coconut, sugarcane spindle or alfalfa callus grown on MS medium. Replicated culture attempts with the persistent stage of RRN were successful in immature coconuts and young coconut leaves. Over 95% of R. palmarum of both sexes from Trinidad contained RRN internally. Over 50% of both sexes were infested internally with > 1000 RRN. Teratorhabditis n. sp. and Diplogasteritus n. sp. were associated internally with both R. palmarum and R. cruentatus. There was no correlation between body length or weight at R. palmarum emergence with the number of RRN (n = 99 weevils). Using R.

Publications: 87/10 to 88/10

GIBLIN, R.M., GERBER, K. and GRIFFITH, R. 1987. Comparison of Rhynchophorus species as vectors of the red ring nematode, Rhadinaphelenchus cocophilus. Journal of Nematology. 19: 524 (Abstr.).

GERBER, K. and GIBLIN, R.M. 1987. Studies on the association of the red ring nematode with the black palm weevil, Rhynchophorus palmarum. Nematropica 18: 7 (Abstr.).

GIBLIN-DAVIS, R.M. and HOWARD, F.W. 1988. Notes on the palmetto weevil, Rhynchophorus cruentatus. Florida State Horticultural Society, Proceedings. 101: (In press).

GIBLIN-DAVIS, R.M., MUNDO-OCAMPO, M., BALDWIN, J.G., GERBER, K. and GRIFFITH, R. 1989. Observations on the morphology of the red ring nematode, Rhadinaphelenchus cocophilus (Nemata: Aphelenchoididae). Revue de Nematologie. (In press).

GIBLIN-DAVIS, R.M. and HOWARD, F.W. 1989. Vulnerability of palms to attack by Rhynchophorus cruentatus (Coleoptera: Curculionidae) and its insecticidal control. Journal of Economic Entomology. (In press).

GIBLIN-DAVIS, R.M., GERBER, K. and GRIFFITH, R. 1989. Laboratory rearing of Rhynchophorus cruentatus with notes on R. palmarum (Coleoptera: Curculionidae). Journal of Economic Entomology (In press).

09.007 CRIS0132252

MANAGEMENT OF NEMATODE PESTS OF CITRUS

DUNCAN L W; NOLING J W; University of Florida, Lake Alfred, **FLORIDA** 33850.

Proj. No.: FLA-LAL-02626 Project Type: STATE
Agency ID: SAES Period: 14 JUL 87 to 30 SEP 92

Objectives: Develop a computer-assisted algorithm to simulate management Tylenchulus semipenetrans on citrus. Develop programs to manage Radopholus citrophilus in citrus.

Approach: Use edaphic, environmental, and census data to develop multiple-point models of nematode and citrus fibrous root growth and decline. Measure relationship between citrus nematode density and fruit yield. Elucidate dose-efficacy functions. Validate all models and promising management options in field experiments. Establish environmental barriers to the spread of R. citrophilus from infested to noninfested groves. Measure effects of establishing trees on vigorous, shallow root systems. Such trees may escape injury by R. citrophilus which effect deeper roots. Trials will investigate use of herbicides vs disking, irrigation and fertilization treatments favoring shallow vs deep root development, and use of systemic nematicides.

Progress: 87/10 to 88/09. Sampling plans were developed for estimating population level of Tylenchulus semipenetrans in citrus orchards. Seasonal changes in populations influenced optimum sample size and, due to less efficient sample mixing, it is necessary to increase the number of subsamples which are processed to maintain precision in soils with significant clay content. Transformation of population counts according to Taylor's Power Law was slightly more effective in homogenizing treatment variance than was log transformation. Grapefruit yield increased nearly 20% and nematicide efficacy doubled when treatment zones were moved from the canopy dripline to beneath the canopy where fibrous root density and nematode level are highest. Concomitant infection of citrus seedlings by the mycorrhizal fungus, Glomus interadices and Tylenchulus semipenetrans reduced stem, root and leaf weights more than when the nematode was alone on the roots. Conversel, although T. semipenetrans reduced stem, leaf and root weights when inoculated alone on citrus seedlings, no effect by the nematode was measured when inoculated with either of two rates of Phytophthora parasitica. Nematodes hatching from roots and soil populations of the nematode per root weight in the soil as well as stem, leaf and root weights declined with increasing amount of fungal inoculum. Repeated annual applications of fenamiphos significantly increased citrus yield and tree quality beginning with the second crop following initial treatment.

Publications: 87/10 to 88/09

DUNCAN, L.W. and MCSORLEY, R. 1987. Modeling Nematode Populations. Vistas on Nematology: A commemoration of the Twenty-fifth Anniversaryu for the Society of Nematologists. 50:377-389.

09.008 CRIS0064819

DEVELOPMENT OF CHEMICAL CONTROL MEASURES FOR PLANT PARASITIC NEMATODES ON PINEAPPLES

APT W J; CASWELL E P; Plant Pathology; University of Hawaii, Honolulu, **HAWAII** 96822.

Proj. No.: HAW00732-H Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Determine the efficacy of experimental nematicides, of synthetic and biological origin. Determine the efficacy of experimental nematicides and their distribution patterns in the soil when applied through a drip irrigation system. Determine pineapple growth response, yields, residue data and efficacy of experimental nematicides applied through a drip irrigation system in full cycle (3-4 years) yield tests.

Approach: Greenhouse pot experiments (60 days) will determine initial efficacy of new nematicides. Field tests (3-6 mos.) will determine profile distribution patterns of nematicides applied through drip irrigation. Yield tests (3-4 yrs.) will evaluate rates and timing of nematicides applied preplant and post-plant. Some preplant treatments will have variable soil moisture levels and time periods prior to application of nematicide. Data taken includes growth response, yield, nematicide efficacy and residue analysis.

Progress: 86/10 to 87/09. Experimental application of nematicides through a drip irrigation system is a continuing program. The potential loss of additional registered nematicides makes improved use patterns of

existing nematicides of critical importance. A field experiment initiated in late 1986 with metham-sodium, 1,3 dichloropropene, fenamiphos and ethoprop will extend through a complete pineapple plant cycle (3-4 yrs). Plant response and yield data are pending. Two of the fumigant type nematicides used in the experiment (metham-sodium and 1,3 dichloropropene normally applied preplant by injection have been successfully applied by drip irrigation, preplant and postplant, without phytotoxicity. A cooperative phase of the experiment with the Dept. of Agronomy and Soils is designed to determine the degradation and movement of fenamiphos in the soil profile when applied by drip irrigation. Data indicate that frequency and amount of irrigation schedules may have a significant influence on the movement of fenamiphos out of the root zone with a reduced nematode control. Soil type has also been shown to influence lateral diffusion of fenamiphos. In a cooperative experiment with the Dole Pineapple Co., Avermectin B(1) was tested for control of the reniform nematode on pineapple. Although nematode populations were reduced, control was not comparable to fumigation with 1,3 dichloropropene and did not prevent reduced plant growth.

Publications: 86/10 to 87/09

APT, W.J. 1987. Nemagation via Drip Irrigation, Journal of Nematology, 19:510 (Abs.).

CASWELL, E.P. and APT, W.J. 1987. Nematode Management on Pineapples in Hawaii--Past, Present and Future, Journal of Nematology, 19:518 (Abs.).

SCHENK, S. and APT, W.J. 1987. Application of Avermectin B(1) Through Drip Irrigation for Control of Rotylenchus Reniformis on Pineapple, Journal of Nematology, 19:556 (Abs.).

09.009 CRIS0136992

CULTURAL AND BIOLOGICAL MANAGEMENT OF NEMATODES IN PINEAPPLE PRODUCTION SYSTEMS

CASWELL E P; APT W J; Plant Pathology; University of Hawaii, Honolulu, **HAWAII** 96822.
Proj. No.: HAW00782-H Project Type: HATCH
Agency ID: CSRS Period: 07 DEC 88 to 30 SEP 91

Objectives: To determine the potential of cultural practices and biological control agents to reduce populations of plant-parasitic nematodes in Hawaiian pineapple soils. To establish quantitative relationships between nematode populations and pineapple growth and yield. To assess the effect of environment on the reniform nematode life cycle. To identify sources of resistance to reniform nematode in pineapple germplasm.

Approach: The objectives will be pursued using a combination of growth chamber, greenhouse and field experiments. Growth chambers will be used to assess reniform nematode population growth in relation to cumulative heat units. Greenhouse experiments are being used to assess the potential of cultural and biological control agents. Field experiments to assess pineapple growth and yield relative to nematode stress are currently underway.

09.010 CRIS0097191

FUNDAMENTAL AND APPLIED ASPECTS OF ANHYDROBIOSIS IN THE RENIFORM NEMATODE, ROTYLECHULUS RENIFORMIS

WOMERSLEY C; APT W J; Plant Pathology; University of Hawaii, Honolulu, **HAWAII** 96822.
Proj. No.: HAW00760-G
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 AUG 85 to 31 JUL 89

Objectives: Determine the biochemical adaptations off the reniform nematodes, Rotylenchulus reniformis to anhydrobiosis and their implications to maintenance of its structural integrity. Establish a sound basis for development and implementation of cultural control measures applicable to R. reniformis and other nematode anhydrobiotes.

Approach: The anhydrobiotic potential of eggs, larvae and preadults of R. reniformis will be studied in drying experiments at varying relative humidities. Revivability of anhydrobiotic stages will be determined in controlled humidities. Carbohydrate and lipid composition of larvae and preadults will be analyzed and monitored at induction of, during and on revival from anhydrobiosis. Above findings will be related to actual moisture levels in nematode-infested pineapple field soil.

Progress: 86/10 to 87/09. Studies on dehydration of freshly hatched second stage larvae and egg sacs of R. reniformmis, using 0.5% agar and 1.0% agarose as optimal media to slow evaporative water loss showed coiling response in more than 60% of larval samples. Uncoiled larvae did not survive dehydration. Coiled larvae survived as preadults. More than 40% larvae survived after 37 days at 97% r.h. Some morphologically intact coiled larvae did not survive. Larvae did not survive direct exposure to 90, 40, and 0% r.h. However, an induction period of ca. 5 days at 97% r.h. before exposure to 90 and 40% r.h. levels for 7 days resulted in 40% survival. A 20% revival rate was obtained for larvae held at 90% r.h. for 9 1/2 months after induction at 97% r.h. Egg masses held at 97% r.h. for 9-16 days showed over 50% hatch on rehydration. No hatch occurred if dehydrated at 90, 40, 0% r.h. Mature egg masses survived better than immature ones and this was enhanced if they are not 80% hatch of eggs after 7 days at 90% r.h. and approximately 50% hatch after 7 days at 40% r.h. Induction of anhydrobiosis in larvae and egg masses of R. reniformis was slow, requiring careful control of evaporative water loss. The successful use of an induction period infers some level of metabolic adaptation. This has yet to be substantiated.

Publications: 86/10 to 87/09

WOMERSLEY, C. 1986. Nematode anhydrobiotes: levels of adaptations to dehydration stress. J. Nematol. 18(4):598.

WOMERSLEY, C. 1986. A re-evaluation of strategies employed by nematode anhydrobiotes in relation to their natural environment. J. Nematol. Vistas on Nematol. CH. 24:165-173.

09.011 CRIS0136719
FUNDAMENTAL AND APPLIED ASPECTS OF ANHYDROBIOSIS IN THE RENIFORM NEMATODE, ROTYLENCHULUS RENIFORMIS

WOMERSLEY C; APT W J; Plant Pathology; University of Hawaii, Honolulu, **HAWAII** 96822.
Proj. No.: HAW00778-G
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 AUG 88 to 31 JUL 89

Objectives: Determine the biochemical adaptations of the remiform nematodes, Rotylenchulus reniformis to anhydrobiosis and their implications to maintenance of its structural integrity. Establish a sound basis for development and implementation of cultural control measures applicable to R. reniformis and other nematode anhydrobiotes.

Approach: The anhydrobiotic potential of eggs, larvae and preadults of R. reniformis will be studied in drying experiments at varying relative humidities. Revivability of anhydrobiotic stages will be determined in controlled humidities. Carbohydrate and lipid composition of larvae and preadults will be analyzed and monitored at induction of, during and on revival from anhydrobiosis. Above findings will be related to actual moisture levels in nematode-infested pineapple field soil.

09.012 CRIS0135798
PATHOLOGICAL AND MANAGEMENT FACTORS CAUSING "PLANTAIN DECLINE"

LIU L J; PANTOJA A; ORAMAS D; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTO RICO** 00927.
Proj. No.: PR-3610 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 89

Objectives: To determine the effect of pathological factors such as nematodes, insects, fungi, and viruses on ratoon productivity. To determine the effect of factors such as sucken management and fertilizer on ratoon productivity.

Approach: Objective 1 will be attained by establishing replicated field trials of plantains in Corozal and Gurabo Substations consisting of different levels or combinations of nematicides, insecticides, and fungicides, and by producing somaclonal variants in vitro as an aid for determining the principal pathological factors responsible for the ratoon deterioration. Roots and soil samples from each plot will be collected periodically to determine population density and pathogenicity of the isolated organisms. The objective 2 will be achieved by including the same replicated field trials of plantains different culture practices, levels and time of fertilizer application, and by producing somaclonal variants as an aid for elucidating management factors which might cause the crop decline.

09.013 CRIS0057100
EVALUATION OF NEMATODE CONTROL PRACTICES IN CROPS OF ECONOMIC IMPORTANCE

ORAMAS D; ACOSTA N; ROMAN J; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTO RICO** 00927.
Proj. No.: PR00247 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 28 FEB 93

Objectives: To evaluate nematicides, alone and concurrently with cultural, physical and biological selected control practices potentially effective for the control of nematodes affecting crops of economic importance in Puerto Rico.

Approach: Preliminary greenhouse tests will be conducted to select effective nematicides and rates and to evaluate, whenever necessary, selected control practices. The most promising treatments will be tested in the field to determine effects on yield and quality, residue levels and phytotoxicity. Field evaluation will be conducted at different sites and will include nematicide treatments alone and concurrently with cultural, physical and biological selected control practices. The evaluation criteria will be nematode population before, after treatments and at harvesting; commodity yield and quality; cost and earning of the treatments; residues in commodities; persistance in the soil; hazard to humans and toxicity to mammals and plants.

Progress: 87/01 to 87/12. Liquid formulations of fenamiphos, carbofuran and fensulfothion were applied alone and in combination with their granular counterparts (butylfos and carbofuran) as soil treatments in yams. Temik 10G as standard and oxamyl 24L as a check were used for comparison. The trial is underway and data are not available yet. A field experiment was conducted to determine the efficacy of terrazole, thiabendazole and aldicarb, alone and in combinations on the control of fungi and nematodes in plantains. They were not effective against root rot. Significant yeild differences over the control were obtained in nematicide-treated plots, regardless of fungicide treatment. Fruit weight was significantly higher in watermelon plots treated with Paecilomyces lilacinus fungus 2 weeks before planting and in carbofuran-treated plots ad compared to control ones. Significant differences in yield over the control were obtained with applications of carbofuran at 2.24 and 4.48 kg/ha. Three cucumber varieties were evaluated as to root knot nematode resistance at the Isabela Substation. There were no significant differences in yields between cultivars Dasher II and Poinsett 76, but the first one was significantly most

resistant than cultivar Geminis 7. Eighteen pumpkin lines were evaluated in the greenhouse as to resistance to M. incognita but only DR-14 and DR-11 were moderately resistant. A survey of 25 commercial farms showed that R. reniformis was the most common nematode associated with papaya.

Publications: 87/01 to 87/12

ECHAVEZ-BADEL, R. 1987. Evaluacion preliminar de la resistencia del pepinillo al nematodo nodulador. Memorias Sociedad Puertorriquena de Ciecias Agricolas, Gurabo, P.R., Nov. 13, p. 21 (Abstr.).

NEGRON, J. and ACOSTA, N. 1987. Studies on host-parasite relationships of Meloidogyne incognita and Coffea arabica cv. Borbon. Nematropica 17(1):71-78.

ORAMAS, D. and ROMAN, J. 1987. Cambios histologicos inducidos en la raiz del platano (Musa acuminata x M. balbisiana, AAB) por 4 especies de nematodos de importancia economica en Puerto Rico.

VICENTE, N., ABREU, E. and MEDINA-GAUD, S. 1987. Chemical control of Meloidogyne incognita, Rotylenchulus reniformis and Anthonomus eugenii in Capsicum annuum and C. frutescens. Nematropica 17(2):163-69.

CM 10 DECIDUOUS AND SMALL FRUITS AND TREE NUTS

10.001 CRIS0031303
PRELIMINARY EXPLORATORY VEGETABLE AND FRUIT RESEARCH IN CENTRAL FLORIDA

WHITE J M; University of Florida, Sandford, **FLORIDA** 32771.
Proj. No.: FLA-SAN-00001 Project Type: STATE
Agency ID: SAES Period: 25 JUN 68 to 01 JAN 99

Objectives: Investigate new problems in vegetable and fruit production in Central Florida.

Approach: Preliminary research investigations will be conducted on vegetables and fruits on quality of water in canals and lake adjacent to vegetable production area.

Progress: 87/09 to 88/10. In a greenhouse trial on 'Blue Lake' grape seedlings, the plant nematodes, Belonolaimus longicaudatus, Meloidogyne incognita, and Criconemella curvatum reproduced rapidly; seedling root and top growth was significantly reduced after 5 months in 15-cm pots initially infested with 1000 B. longicaudatus or 5000 eggs of M. incognita. Disease problems affecting production of lilly turf (Ophiopogon japonicus) were investigated. Fungicide drenches did not decrease multiplication time or production for container-grown lilly turf plants. Heat treatments or fungicide soaks were not effective in eradicating root pathogens from propagation stock. Slow growth and virus-like mottle symptoms suggested that a virus is present in all propagation material. Micro-propagation with tissue culture methods was used to regenerate plantlets from meristem cultures. Propagation stock of an ornamental Prunus spp. hybrid were freed of the systemic bacterial pathogen Xanthomonas campestris pv prunii by meristem culture. Plants were regenerated in tissue culture but cannot yet be induced to form roots. Serious production losses to container-grown azaleas widely considered to be losses from disease were found to be caused by excessive use of cypress sawdust and chips in the growth media. Epidemiological studies demonstrated that Fabrea maculatum the incitant of entomosporium leaf spot of Photinia continually produced large numbers of spores during the hot summer months as well as during cooler months.

Publications: 87/09 to 88/10
NO PUBLICATIONS REPORTED THIS PERIOD.

10.002 CRIS0140666
HORTICULTURAL CROP PRODUCTION SYSTEMS FOR HILL-LANDS OF THE (UPPER) MID-SOUTH

MAKUS E J; WEHUNT E J; BROWN M A; South Central Family Farms Research Unit; Agricultural Research Service, Booneville, **ARKANSAS** 72927.
Proj. No.: 6227-23240-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Improve yield, quality, cost of production, and season availability of small fruits on hill-lands of the mid-south through improved management practices and the evaluation of new crops and cultivars.

Approach: New and existing cultivars of small fruits will be tested under different management strategies to determine their adaptability and potential for culture on hill-lands of the mid-south. The effects and interrelationships of nutrition, water and soil management, plant population, plant training, and control of pests, nematodes, and diseases on establishment, yield, survival of plants, and the quality and the utilization of produce will be studied. The findings will be incorporated into management systems for hill-land farms of the mid-south.

Progress: 87/01 to 87/12. In a 2 yr. experiment, supplemental calcium applied as "Nutri-cal" gypsum, CaNO3 or in combination decreased decay of 'Fern' and 'Cardinal' fruit held 2 days at 21 C by typically 19%. Supplemental Ca increased leaf blade Ca++, but fruit Ca, firmness, % SS, acidity and Ca++ were not affected. Windbreak and training material effected the fruit quality (appearance) of field grown European cucumbers. Windscreens reduced air movement over 50% and increased the actual % US Fancy and US No. 1 fruit by 10%. Maximum levels of leaf blade aluminum (2473 ppm) were found to accumulate in vegetable amaranth grown in pH 6.6 soil and low phosphorus fertility. Soil applied Al+++ reduced plant ht, leaf blade fr wt, protein-N, chlorophyll and P but increased Mn (dry wt basis). Leaf blade Al+++ was negatively correlated with plant ht, dry wt, available soil P, leaf blade P and positively correlated with Fe. Increasing amaranth vegetative growth was a function of decreasing soil pH between 7.4 and 4.4. Scion establishment was begun in the pecan experiments. No nematode population trends indicating pathogenicity were seen in pecan tests. In a planting of 17 herbs most grew well although there was heavy weed growth. Populations of Pratylenchus spp and Xiphinema spp were present in soil around most of the herbs. Neither soil solarization nor fumigation increased yields of strawberries. Meloidogyne arenaria and juveniles of an unidentified heterodera sp was found in an ash/elm regrowth area on the station.

Publications: 87/01 to 87/12
MAKUS, D.J. 1986. A novel approach to fresh market cucumber production. Proc. Ark. State Hort. Soc. pp. 54-59.
MAKUS, D.J. and MORRIS, J.R. 1986. Sensory and fruit quality differences between rabbiteye and highbush blueberries. Proc. Ark. State Hort. Soc. pp. 109-113.
MAKUS, D.J. 1987. Soil pH and supplemental phosphorus affects vegetable amaranth performance. HortSci. 22(5):731.
MAKUS, D.J. and MORRIS, J.R. 1987. Highbush vs. rabbiteye blueberry: A comparison of fruit quality. Ark. Farm Res. 36(3):5.
MORRIS, J.R., MAKUS, D.J., and MAIN, G.L. 1987. Small fruit quality as affected by point of origin: Distant vs. local. HortSci. 22(5):1048. and Farming Systems Symp. Fayetteville, AR.

WEHUNT, E.J., CLARK, J.R., BYERS, P.L., ARRINGTON, E.H., and ASELAGE, J.M. 1986. Nematodes of peaches - a preliminary survey in Arkansas. Proc. Ark. State Hort. Soc. pp. 84-90.
WEHUNT, E.J., GOLDEN, A.M., WEAVER, C.F. and RODRIQUEZ-KABANA, R. 1987. First report of a Tylenchulus sp on peach in Alabama, Arkansas, Georgia, and South Carolina. Ann. Nematol. 1:127-128.

10.003 CRIS0141710
GENETIC IMPROVEMENT OF STONE FRUITS AND GRAPES

RAMMING D W; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-20010-005-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 JUL 86 to 30 JUN 87

Objectives: Develop improved stone fruit and grape rootstocks with nematode, phylloxera(grapes) and other pest resistance, scion compatibility and ease of propa- gation. Develop genotypes with improved fruit quality, shippability, disease and insect resistance, and extended maturity season. Develop improved seedless table and raisin grape genotypes.

Approach: Develop innovative breeding techniques for genetic studies, character evaluation, and germplasm development. Produce desired genetic combina- tions by controlled hybridization or tissue culture when feasible. Develop appropriate screening methods to detect the desired genotypes based on datagathered for genetic studies and using up-to-date data collection devices and computer analysis. Evaluate scion and rootstock genotypes for superior genotypes and potential cultivars in experimental and commercial orchards.

Progress: 87/01 to 87/06. Embryos from one week old embryos did not respond to embryo rescue as they did in 1986. Plants were recovered from embryos four & five weeks old. Rescue of embryos from crosses for early-ripening Prunus and seedless x seedless grapes continues. A selection from seedless x grape crosses having almost undetectable seed traces and berries larger than either parent was saved. This shows transgressive segregation for large berries and small seed traces, both very important traits. A greenhouse screening procedure for lesion nematodes was developed. Prunus tomentosa was identified in greenhouse nematode trials as resistant to lesion nematodes. F2 progeny of an earlyripening x a late slow-ripening nectarine fruited this year.

Publications: 87/01 to 87/06
RAMMING, D.W. & TANNER, O. 1987. 'Mayfire' nectarine. Fruit Var. J. 41:80-81.
RAMMING, D.W. & TANNER, O. 1987. 'Goldcrest' peach. Fruit Var. J. 41:52-53.

10.004 0143428
GENETIC IMPROVEMENT FOR RESISTANCE TO NEMATODES FOR STONE FRUIT ROOTSTOCKS

RAMMING D W; LEDBETTER C A; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-21220-001-03T
Project Type: INHOUSE
Agency ID: ARS Period: 01 AUG 89 to 31 JUL 94

Objectives: Develop protocols for testing rootstock material for resistance/tolerance to lesion and ring nematodes. Identify candidate rootstock material that is resistant/tolerant to lesion and ring nematodes.

Approach: Adapt and improve ring screening method developed in Georgia to California greenhouse conditions. Use greenhouse lesion screen developed at Fresno to identify resistant/tolerant material. When ready, screen for ring resistance/tolerance as well. Make final test for resistance in the field. Documents trust agreement with California Prune Board.

Progress: 89/08 to 89/12. Sufficient plant materials were collected during the summer of 1989 to screen 40 candidate rootstocks for resistance/tolerance to root lesion nematode (Pratylenchus vulnus) using standardized procedures developed during 1986. One of eight candidate rootstocks screened for lesion nematode resistance/tolerance during 1988 appears tolerant of this pest. Although there were no significant differences between nematode populations infesting the root systems of the eight rootstocks, highly significant differences existed for shoot and root weights. The tolerant rootstock PI442380, will be used in hybridizations during the 1990 bloom to incorporate lesion nematode tolerance into existing root knot nematode resistant rootstocks. Screening procedures for ring nematode (Criconemella xenoplax) have not yet been finalized; however, it was demonstrated during 1989 that sugar flotation-centrifugation is the most effective extraction procedure for establishing ring nematode populations on candidate rootstocks. This method will be used exclusively in the future. An experiment has been initiated to determine whether or not there are differences in ring nematode population establishment between candidate rootstocks in short term greenhouse tests. Forty-three specific crosses were performed at bloom, 1989, to combine root knot and root lesion nematode resistance. Some hybridizations have been successful.

Publications: 89/08 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

10.005 0144425
DEVELOPMENT OF ROOTSTOCK RESISTANT TO LESION AND RING NEMATODES

RAMMING D W; LEDBETTER C A; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-21220-001-01T
Project Type: INHOUSE
Agency ID: ARS Period: 01 MAR 89 to 28 FEB 94

Objectives: Develop protocols for testing rootstock material for resistance/tolerance to lesion and ring nematodes. Identify candidate rootstock material that is resistant/tolerant to lesion and ring nematodes.

Approach: Adapt and improve ring screening method developed in Georgia to California greenhouse conditions. Use greenhouse lesion screen developed at Fresno to identify resistant/tolerant material. When ready, screen for ring resistance/tolerance as well. Make final test for resistance in the field. (Documents Trust Fund Agreement with Almond Board of California).

Progress: 89/03 to 89/12. Sufficient plant materials were collected during the summer of 1989 to screen 40 candidate rootstocks for resistance/tolerance to root lesion nematode (Pratylenchus vulnus) using standardized procedures developed during 1986. Dne of eight candidate rootstocks screened for lesion nematode resistance/tolerance during 1988 appears tolerant of this pest. Although there were no significant differences between nematode populations infesting the root systems of the eight rootstocks, highly significant differences existed for shoot and root weights. The tolerant rootstock PI442380, will be used in hybridizations during the 1990 bloom to incorporate lesion nematode tolerance into existing root knot nematode resistant rootstocks. Screening procedures for ring nematode (Criconemella xenoplax) have not yet been finalized; however, it was demonstrated during 1989 that sugar flotation-centrifugation is the most effective extraction procedure for establishing ring nematode populations on candidate rootstocks. This method will be used exclusively in the future. An experiment has been initiated to determine whether or not there are differences in ring nematode population establishment between candidate rootstocks in short term greenhouse tests. Forty-three specific crosses were performed at bloom, 1989, to combine root knot and root lesion nematode resistance. Some hybridizations have been successful.

Publications: 89/03 to 89/12
ND PUBLICATIONS REPORTED THIS PERIDD.

10.006 0145115
GENETIC IMPROVEMENT OF STONE FRUIT ROOTSTOCKS FOR RESISTANCE TO NEMATODES

RAMMING D W; LEDBETTER C A; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-21220-001-02T
Project Type: INHDUSE
Agency ID: ARS Period: 01 JUN 89 to 31 MAY 94

Objectives: Develop protocols for testing rootstock material for resistance/tolerance to lesion and ring nematodes. Identify candidate rootstock material that is resistant/tolerant to lesion and ring nematodes.

Approach: Adapt and improve ring screening method developed in Georgia to California greenhouse conditions. Use greenhouse lesion screen developed at Fresno to identify resistant/tolerant material. When ready, screen for ring resistance/tolerance as well. Make final test for resistance in the field. Documents Trust Agreement with California Tree Fruit Agreement.

Progress: 89/06 to 89/12. Sufficient plant materials were collected during the summer of 1989 to screen 40 candidate rootstocks for resistance/tolerance to root lesion nematode (Pratylenchus vulnus) using standardized procedures developed during 1986. One of eight candidate rootstocks screened for lesion nematode resistance/tolerance during 1988 appears tolerant of this pest. Although there were no significant differences between nematode populations infesting the root systems of the eight rootstocks, highly significant differences existed for shoot and root weights. The tolerant rootstock PI442380, will be used in hybridizations during the 1990 bloom to incorporate lesion nematode tolerance into existing root knot nematode resistant rootstocks. Screening procedures for ring nematode (Criconemella xenoplax) have not yet been finalized; however, it was demonstrated during 1989 that sugar flotation-centrifugation is the most effective extraction procedure for establishing ring nematode populations on candidate rootstocks. This method will be used exclusively in the future. An experiment has been initiated to determine whether or not there are differences in ring nematode population establishment between candidate rootstocks in short term greenhouse tests. Forty-three specific crosses were performed at bloom, 1989, to combine root knot and root lesion nematode resistance. Some hybridizations have been successful.

Publications: 89/06 to 89/12
ND PUBLICATIONS REPORTED THIS PERIDD.

10.007 CRIS0143258
NPV, BACILLUS THURINGIENSIS, NEMATODES TO REDUCE POSTHARVEST INSECT LOSSES TO FRUITS & NUTS

VAIL P V; LINDEGREN J E; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-43000-018-00D
Project Type: INHDUSE
Agency ID: ARS Period: 01 DCT 88 to 30 SEP 91

Objectives: Develop selected strains of entomogenous nematodes with increased efficacy & application methods that optimize their control of postharvest/quarantineinsect pests. Develop micobial control (viruses & bacteria) agents againstinsect pests of postharvest dried fruit/nuts. Determine toxicity of plant produced Bt endotoxins to codling moth, Indianmeal moth and navel orange- worm. Determine resistance of Indianmeal moth to granulosis viruses.

Approach: Evaluate the selection potential of entogenous nematodes for improved infectivity & virulence to refractive hosts & increased survival under adverse storage or field conditions. Determine if nematode efficacy for

control of navel orangeworm, codling moth, tephritid fruit flies & other posstharvest/quarantine insect pests can be enhanced by spray formulations,applicators & uniform droplet size. Test the efficacy for control of moth &beetle pests of postharvest dried fruits & nuts of a new baculovirus with a broad host range & new Bacillus thuringiensis strains. Bioassay two Bt endotoxins derived from plants against codling moth, Indianmeal moth & navel orangeworm. Determine toxicity & efficacy of walnut produced endo- toxins from embryos, seedlings, leaves and nuts. Evaluate engineered walnuts for field and postharvest protection. Five strains of IMM will be evaluated for susceptibility to granulosis viruses and then selected for resistance to the virus.

10.008 CRIS0049393
DETERMINE EFFICACY OF PATHOGENS FOR CONTROL OF QUARANTINE AND HORTICULTURAL INSECT PESTS

LINDEGREN J E; Ecology & Bio Control Res USDA Hort Crops Res Lab; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-43000-006-00D
Project Type: INHOUSE
Agency ID: ARS Period: 30 SEP 84 to 30 SEP 89

Objectives: Develop standards for production storage life of entomogenous nematodes; develop spray methods for application of entomogenous nematodes; develop methods for utilizing entomogenous nematodes and other pathogens for the control of tephritid fruit flies, navel orangeworm and other problem insects.

Approach: Determine nematode concentration counts by weight, the o2 consumption of nematodes at different temperatures in storage and select a suitable pack- aging material that will provide for maximum nematode shelf life; determineif the efficacy of entomogenous nematodes can be enhanced by additives, foam formulations and/or selected applications timing; evaluate laboratory and field applications of entomogenous nematodes and other pathogens as a soil drench or as an adult bait for the control of tephritid fruit flies.

Progress: 86/01 to 86/12. An effective in vivo rearing procedure has been developed that generates only the infective juvenile stage nematodes, does not require access to incubators, autoclave or toxic disinfectants, provides an aerobic high relative humidity environment, screens against unwanted contaminants, and produces approximately 150,000 infective juveniles nematodes per host wax moth larva. This method provides a readily available standardized and quality controlled source of freshly harvested nematodes for laboratory and small scale field investigations and is currently being successfully used by other research facilities. The survival and biological control potential of the entomogenous nematode Steinernema feltiae Filipjev was determined in newly split almonds under field conditions. Nematode suspensions (ca. 100 infective juveniles) were inoculated into newly split almonds. Nematode survival was assessed at the initiation of the test and at subsequent 24-hour intervals by the addition of two insectary-reared sixth instar navel orangeworm, Amyelois transitella (Walker), larvae per nut. The nematodes survived in the field and were invective to the larvae of the navel orangeworm for seven and eight days in Davis and Fresno orchards, respectively (temperature range 9C to 35C).

Publications: 86/01 to 86/12
LINDEGREN, J.E., RIJ, R.E., ROSS, S.R. and FOUSE, D.C. 1986. Respiration rate of Steinernema feltiae infective juveniles at several constant temperatures. J. Nematol. 18:221-224.
LINDEGREN, J.E. and VAIL, P.V. 1985. Susceptibility of Mediterranean fruit fly, melon fly and oriental fruit fly (Diptera: Tephritidae) to the entomogenous nematode, Steinernema feltiae in laboratory tests. Environ. Entomol. 5:465-468.

10.009 CRIS0098723
BIOLOGICAL CONTROL OF PLANT-PARASITIC NEMATODES

JAFFEE B A; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4666-H Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Identify soils suppressive to Meloidogyne spp.; determine nature of suppression. Study interaction of Criconemella spp. and its antagonists. Assess potential of zoosporic fungi for biocontrol of Xiphinema spp. Study soil ecology and organism interactions to enhance understanding of potential for nematode biocontrol.

Approach: Assays will be developed to measure levels of suppression of M. incognita in 20 tomato fields. The interaction of C. xenoplax and H. rhossiliensis will be quantitatively described. Parasites will be isolated from X. index and X. californicum; (relative susceptibility of different stages of nematodes to parasitism will be determined). Biology and ecology of antagonists of M. incognita, C. xenoplax, and Xiphinema spp. will be studied to learn how to maximize impact of antagonists on nematodes.

Progress: 87/01 to 87/12. Population densities of Criconemella xenoplax and parasitism by the nematophagous fungus Hirsutella rhossiliensis were quantified at 6 week intervals for 1 year in three peach orchards. Parasitism of the nematode by the fungus was density dependent in 25% of the data sets. Population densities of C. xenoplax were quite stable. The stability appeared to reflect host carrying capacity (root density) rather than density-dependent parasitism by the fungus. Verticillium chlamydosporium and Paecilomyces lilacinus, fungal egg parasites of Meloidogyne incognita, were detected in 9 and 13 of 22 tomato field soils, respectively. The presence of these fungi was not correlated with soil organic matter, pH, texture, or other

physical or chemical characteristics. Although these fungi could be recovered from significant proportions of egg masses on tomato roots grown in field soil in the greenhouse, few eggs were parasitized. The bacterial parasite Pasteuria penetrans reproduced in cultures containing M. javanica and Agrobacterium rhizogenes transformed roots.

Publications: 87/01 to 87/12

JAFFEE, B.A., POWELL, C.A. and DERR, M.A. 1986. Incidence of Prunus necrotic ringspot virus in some Pennsylvania peach orchards and nurseries. Plant Disease 70:688-689.

JAFFEE, B.A., HARRISON, M.B., SHAFFER, R.L. and STRANG, M.B. 1987. Seasonal population fluctuations of Xiphinema americanum and X. rivesi in New York and Pennsylvania orchards. Journal of Nematology 19:369-378.

EAYRE, C.G., JAFFEE, B.A. and ZEHR, E.I. 1987. Suppression of Criconemella xenoplax by the nematophagous fungus Hirsutella rhossiliensis. Plant Disease 71:832-834.

JAFFEE, B.A. and SHAFFER, R.L. 1988. Parasitism of Xiphinema americanum and other zoosporic fungi in soil solution, Baermann funnels, or soil. Nematologica. In press.

JAFFEE, B.A., NYCZEPIR, A.P. and GOLDEN, A.M. 1987. Criconemella spp. in Pennsylvania peach orchards with morphological observations of C. curvata and C ornata. Journal of Nematology 19:420-423.

JAFFEE, B.A., GLENN, D.M., FORER, L.B. and SHAFFER, R.L. 1988. Effect of soil texture on Xiphinema americanum and X. rivesi. Nematologica. Accept for pub.

10.010 CRIS0082578

NEMATODE MANAGEMENT IN NURSERIES: DECIDUOUS FRUITS, NUTS, VINES AND BERRIES

MAGGENTI A R; RASKI D J; WESTERDAHL B B; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4038-H Project Type: HATCH Agency ID: CSRS Period: 01 MAY 87 to 30 SEP 91

Objectives: To develop and maintain nematode free quality planting stock for California orchards, vineyards and berry plantings. We will continue to investigate and develop effective and economical nematode management programs for the control of nematodes in field grown nursery stock.

Approach: A wide variety of management programs will be investigated. Among these will be chemical dips, hot water treatments, and cultural modification such as crop rotation, resistant varieties and rootstocks. Effective and economical field soil treatments will also be investigated.

Progress: 87/01 to 87/12. A. Ph.D. thesis was completed by John Griesbach. The research was concerned with the validity of the species of Xiphinema californicum that was separated out of X. americanum by Lamberti in 1979. This action created a great deal of confusion concerning nematode vectored viruses in California. X. californicum was collected from ten sites throughout the southern half of the state. These populations were used to establish vector specificity with the NEPO viruses that X. americanum sensu lato is known to transmit. The morphometric variability of the populations after being grown on the same host, were through discriminant analysis compared to type specimens and congenerics from California. It was concluded that X. californicum is a synonym of X. americanum. This was an important finding that clarified and verified the vector of the ringspot viruses in California.

Publications: 87/01 to 87/12

GRIESBACH, J. 1987. The morphometrics and vector specificity of Xiphinema americanum sensu lato in California. Ph.D. Thesis.

10.011 CRIS0066703

THE PATHOGENICITY AND CONTROL OF NEMATODES PARASITIZING GRAPEVINES IN CALIFORNIA

RASKI D J; FERRIS H; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-3124-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Management of nematodes in grapevines. Pathogenicity of nematode species on grape cultivars and rootstocks. Environmental suitability and ecological relationships of nematodes in vineyards.

Approach: Field trials are conducted to evaluate nematode and virus resistant rootstocks that tolerate Phylloxera. The efficacy of rootstocks for control of the nematode and virus complex will be evaluated by continued monitoring. New rootstocks and germplasm will be evaluated for management potential of nematodes parasitizing grapevines. Resurgence of nematodes into treated soils will be evaluated. Nematode effect on rates of photosynthesis and food demands of nematode populations of different size and age structure will be determined.

Progress: 87/01 to 87/12. Monitoring of field trials of rootstocks 039-16 and 043-43, resistant to Xiphinema index and grapevine fanleaf virus, continues. X. index has not been recovered from either rootstock in the field, although there have been some incidences of grapevine fanleaf in scions on rootstock 039-16. In parallel studies, the susceptibility of rootstocks 039-16, 043-43 and St. George to three species of rootknot nematode (Meloidogyne spp.) has been tested. M. hapla, M. incognita, and M. javanica were supported in moderate populations on 039-16; however, they occured only at extremely low population densities on 043-43. Rootstock St. George appeared to have an equal level of resistance to M. hapla as that seen in 043-43. Six years after replanting of grapes in an old vineyard site, grapevine fanleaf virus occurred in 3-6% of the vines in soil treated with methyl bromide, compared with 35% of the vines in soil treated with Telone II. Untreated vines had 30-60% infection. Yields have been superior in the soil fumigation treatments.

Publications: 87/01 to 87/12
RASKI, D.J. and GOHEEN, A.C. 1988. Comparison of 1,3 dichloropropene and methyl bromide for control of Xiphinema index and grapevine fanleaf degeneration complex. Amer. J. Enol. Vitic. In press.
RASKI, D.J. 1988. Compendium of Grape Diseases. Eds. Goheen, A.C. and Pearson, R.C. American Phytopathological Society. In press.

10.012 CRIS0134683
GRAPEVINE ROOTSTOCK BREEDING PROGRAM

MULLINS M G; Viticulture & Enology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-VIT-4933-H Project Type: HATCH
Agency ID: CSRS Period: 10 MAY 88 to 30 SEP 92

Objectives: Produce new genetic material by interspecific/generic hybridization (Vitis and Muscadinia) incorporating resistance to Fanleaf Virus vectored by Xiphenema spp, other plant pathogenic nematodes and biotypes of phylloxera. Combine selection for resistance to soil borne pests and diseases with selection for size control of scion cultivars.

Approach: Raising of hybrids Muscadinia and Vitis sp, use of techniques for accelerated turnover of generations, screening for resistance to nematodes, phylloxera and Fanleaf Virus (ELISA). Selection for rootstock effect on vigor of scion.

10.013 CRIS0135298
GRAPE ROOTSTOCK INVESTIGATIONS

MULLINS M G; Viticulture & Enology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-VIT-4946-H Project Type: HATCH
Agency ID: CSRS Period: 25 JUL 88 to 30 SEP 92

Objectives: Identify and investigate the performance of grape rootstocks in coastal and inland valley locations on sites infested with phylloxera, especially with respect to the newly identified biotype "B" phylloxera; and/or nematodes, with special attention to sites infested with the dagger nematode (Xiphinema index)/fanleaf virus complex.

Approach: In conjunction with entomologists and nematologists, identify sites infested with the above listed pests and establish rootstock trials, utilizing rootstocks of European origin as well as those resulting from previous UC research (H.P. Olmo and L.A. Lider), grafted with scions of current commercial importance.

10.014* CRIS0085802
IMPROVEMENT OF CHEMICAL APPROACHES TO NEMATODE CONTROL FOR ESTABLISHED TREES AND VINES

MCKENRY M V; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4166 Project Type: STATE
Agency ID: SAES Period: 01 NOV 87 to 30 SEP 92

Objectives: Determine the longevity, efficacy and potential for groundwater contamination of several nematicides applied to soils with varying microbial populations.

Approach: Radio-labeled fenamiphos will be used to test various soils and half-lifes determined. Efficacy data will be collected following use of various nematicides in field situations. We will monitor fruit residues, nematode population densities, yield data, and nematicide mobility to groundwater.

Progress: 87/01 to 87/12. One goal of our work is an assessment of fenamiphos (Nemacur registered trademark) half-life in soils with differing cropping, fumigation and nematode treatment histories. We have now assayed for fenamiphos and its metabolites 300 days after treatments to one soil with 6 different pesticides use histories. Chemical analyses with HPLC has proven inadequate and the work is being repeated with GLC. A second goal is the identification of nematicidal agents from sources with greatest potential for eventual biodegradation. To this end we have identified that water extracts from several crops greatly deplete dissolved oxygen levels of a soil solution. These oxygen depleted solutions provide 60 to 72 hr of nematode paralysis, in vitro. Extracts from crops such as Tagetes spp., Vicia sativa and Eschscholtzia californica can also cause direct lethal effects to mobile life stages of nematodes. Extracts of these lethal agents have now been applied to field soils via dripper, mister and direct incorporation. Results have been mixed but nematodes were definitely impacted in 11 of 14 field treatments. This new area of study offers growers the potential to protect their crops from nematodes by the growing and proper incorporation of crop residues. Refinement of dosages and timing of application via drip irrigation systems has led to grower acceptance and usage of Nemacur on a large percentage of vineyards in the vineyards of the Coachella Valley.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

10.015 CRIS0024384
DISEASES OF COLORADO FRUIT CROPS

LARSEN H J; Horticulture; Colorado State University, Fort Collins, **COLORADO** 80523.
Proj. No.: COL00079 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 91

Objectives: To characterize and identify potential control methods for orchard replant problems in Colorado. To determine the occurrence, distribution, significance,

alternate hosts, and vevtors of virus and mycoplasma diseases of fruit crops. To determine levels of tolerance/susceptibility of fruit crops and alternate hosts to these diseases and viable control options. To determine the occurrence, distribution, and significance of phytoparasitic nematodes in Colorado's fruit-producing soils, their migration rates back into disinfested soils, and the roles of weed hosts as population reservoirs.

Approach: Orchard replant problems will be examined through field and greenhouse tests of varioius control options (soil fumigation, heating, fallowing, etc.). Field-based inoculation studies for expression of peach mosaic virus symptoms will be done for newer peach and nectarine varieties, and field samples of tree roots collected and assessed via DAPI staining and fluorescence microscopy for presence of mycoplasma. Phytoparasitic nematode migration rates and the influence of weed host death will be determined using PVC soil columns.

Progress: 87/01 to 87/12. Sterol inhibitor fungicides (triadimefon at 140 g ai/ha; diniconizole at 168 g ai/ha; myclobutanil at 280 g ai/ha; fenarimol at 105 g ai/ha provided good control (60-68%) of shoot infection by apply powdery mildew on Jonathan and Rome Beauty apples during 1987. These materials generally protected fruit from economic russet when 14 day spray intervals were not exceeded during the 6-8 weeks after bloom. Diniconizole and triadimefon provided best control of fruit russet (70%, on Jonathan). Previous season applications of triadimefon at 210 g ai/ha provided 79-86% control for overwintering mildew infections in Jonathan and Rome Beauty buds, respectively. Second season growth of peach trees in orchard replant sites soil loosened to 1.2-1.5 m depth before planting (backhoe or blasting) continued to be better (2X and 2.6X, respectively) than that of trees in non-soil-loosened sites. Pre-plant fall site fumigation with 0.45 kg of 67:33% methyl bromide:chloropicrin continued to provide the best growth response (2.1-2.9X) of any fumigants or nematicides used. Second year response by apple to pre-plant soil loosening and fumigation (with 0.68 kg of 98:2% methyl bromide:chloropicrin) was less than that observed the first year (1.5X vs. 1.7X and 1.5X vs 1.2X, respectively). Alternating applications of azinphos-methyl at 1.12 kg ai/ha and fenpropathrin at 336 g ai/ha on a 4 spray schedule (5/15, 6/4, 6/29, & 7/24) reduced two spotted mite populations on Golden Delicious apples by 70%. Codling moth fruit injury was reduced by 54%.

Publications: 87/01 to 87/12

BULLA, A.D. 1987. Insecticide trials & pyrethroid testing. Proc. West. Colo. Hort. Soc. 44:28-31.

LARSEN, H.J. 1987. Orchard diseases and their control. Proc. West. Colo. Hort. Soc. 44:76-80.

LARSEN, H.J. 1987. Evaluation of fungicides for control of powdery mildew, 1986. (Apple). Fungicide & Nematicide Tests 41: (In press).

LARSEN, H.J., CRANSHAW, W.S. and YU, K.S. (eds.). 1987. Colorado Tree Fruits: 1987 Pest and Crop Management Guide. Ext. Bull. XCM-41, CSU Coop. Ext., Ft. Collins. 80p.

CRANSHAW, W.S., LARSEN, H.J. and RENQUIST, A.R. (eds.). 1987. Colorado Small Fruits: 1987 Pest Management Guide. Ext. Bull. XCM-49, CSU Coop. Ext., Ft. Collins. 41p.

10.018 CRISO130275

NEMATODE COLONIZATION OF FUMIGATED ORCHARD SOILS FROM ADJACENT PLANT ROOT ZONES

LARSEN H J; BECK K G; Horticulture; Colorado State University, Fort Collins, **COLORADO** 80523.

Proj. No.: COL-53-2088
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 SEP 86 to 30 SEP 88

Objectives: To determine: the rate of phytoparasitic nematode immigration into disinfested soils from surrounding untreated soils. The role of weeds and grasses as inoculum reservoirs for phytoparasitic nematodes. The effect of herbicide-induced host death on the dynamics of phytoparasitic nematode emigration from host root zones.

Approach: Nematode migration rates will be measured by timed interval sampling of bait plant root zones in greenhouse trough-planters and in fumigated field plots, both with laterally-placed inoculum plants. Effects of herbicide-induced host death will be studied similarly with inoculum plants killed by herbicide after establishment. Weed and grass suitability as phytoparasitic nematode hosts will be first examined by field sampling of weed and grass root zones. Weed, grass, and fruit tree host suitability will be further assessed by measuring nematode population changes through time in root zones of plants inoculated with phytoparasitic nematodes and grown in greenhouse pots and/or in field-plots.

Progress: 87/01 to 87/12. Xiphinema sp. (dagger nematodes) migrated 15-30 cm laterally over 4 months in high clay content orchard soils during a non-repeated greenhouse study. Field studies also observed that Xiphinema sp. migrated up to 60 cm laterally over 4 months into fumigated high clay orchard soil. Possible movement of these nematodes by advancing soil water front associated with furrow irrigation events is suspected. Root infestations and knots caused by Meloidogyne sp. (root knot nematodes) were observed during 1987 on peach and on Lactuca scariosa (prickly lettuce), a common orchard and roadside weed in some western Colorado locations. Criconemella (Macroposthonia) xenoplax was observed for the first time from orchard soils in western Colorado. It was found in a mixed sweet cherry, apricot, & peach block with sod undercover. Greenhouse pot cultures of Criconemella xenoplax, Meloidogyne sp., & Xiphinema sp. were initiated.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

10.017 CRIS0136966
METHODS TO ALLEVIATE ORCHARD REPLANT PROBLEMS IN COLORADO

LARSEN H J; Horticulture; Colorado State University, Grand Junction, **COLORADO** 81503.
Proj. No.: COLW-8802147 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 88 to 31 JAN 91

Objectives: To compare the benefits of various soil treatments and site preparation methods on early growth of apple and peach trees replanted into soils previously planted to those crops in Colorado.

Approach: Two apple and two peach field studies will be set up at peach and apple replant sites in western Colorado, one for each fruit type to examine chemical effectivity and one for each fruit type to examine the interaction of soil fumigation and fertilizer applications. Soils will be treated in situ during fall 1988 or spring 1989, with trees planted spring 1989. Initial and annual measurements of trunk circumference and cross-sectional area will be used to assess tree growth over their first two years growth, and relationships of tree growth to soil nutrition changes and phytoparasitic nematode populations will be examined.

10.018 CRIS0098677
NONCHEMICAL MEANS OF REDUCING PLANT DISEASES CAUSED BY NEMATODES AND NEMATODE-FUNGUS INTERACTIONS

LA MONDIA J A; Plant Pathology & Ecology; Connecticut Agri Expt Station, New Haven, **CONNECTICUT** 06504.
Proj. No.: CONH00686 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 86 to 30 JUN 90

Objectives: To reduce diseases of strawberry and tobacco by nonchemical means through an understanding of the biology and ecology of nematode-fungus interactions. Determine whether Pratylenchus penetrans and Rhizoctonia fragariae interact synergistically to cause black root rot of strawberry. Determine whether synergism between Globodera tabacum and Fusarium oxysporum f. sp. nicotianae increases wilt of broadleaf tobacco. Determine the threshold populations of each pathogen to assess whether management of either the nematode or the fungus alone can reduce disease. Determine whether manipulating soil organic matter and the carbon to nitrogen ratio can decrease nematode numbers through predation and increase competition between nonpathogenic and pathogenic Fusaria and Rhizoctonia.

Approach: The effect of different population levels of nematodes and fungi on disease incidence will be studied in factorial experiments using a split-root design in the laboratory and microplots in the field. Nematodes and fungi will be added singly or together to either or both halves of a split-root system or to microplots to determine threshold populations and the nature of pathogen interactions. Organic amendments that differ in carbon to nitrogen ratio and that have been inoculated with avirulent Fusarium spp. will be added to soils either previously infested or inoculated later with virulent F. oxysporum. Studies of competition between these fungi will utilize genetically marked isolates.

Progress: 87/01 to 87/12. The tobacco cyst nematode, Globodera tabacum, increased the incidence and severity of wilt caused by Fusarium oxysporum on both MD and CT tobacco. Experiments in the greenhouse and in field microplots indicate that F. oxysporum densities of 10 to 10 CFU per cm soil are necessary to approach 100% disease incidence. G. tabacum populations above 10 juveniles per cm soil increased disease at low fungal densities. Resistance to G. tabacum has been identified in 2 flue-cured tobacco lines. Resistant plants stimulate nematode hatch but allow few nematodes to develop & reproduce, resulting in 70 to 80% population decline in the field and greenhouse. In a survey of CT strawberry fields infested with binucleate Rhizoctonia spp., severe root rot symptoms were associated with the presence of lesion nematodes, Pratylenchus penetrans. P. penetrans root infection increased root rot caused by 3 isolates of binucleate Rhizoctonia (AG A,G & I) and decreased total root length. A greenhouse test of host efficiency indicated that rotating to oats or pumpkins could decrease nematode densities compared to growing continuous strawberries. Nitrate reductase deficient-mutants of F. oxysporum pathogenic to asparagus were obtained. The vegetative compatibilities of these isolates were found to be very diverse. Thus, any soil inhabiting Fusaria may cause disease even when crowns are grown in areas not previously planted to asparagus.

Publications: 87/01 to 87/12

LA MONDIA, J.A. 1987. Interactions between the tobacco cyst nematode and Fusarium wilt in Connecticut broadleaf tobacco. Phytopathology 77(1):119 (Abstract).

LA MONDIA, J.A. and TAYLOR, G.S. 1987. Influence of the Tobacco Cyst Nematode (Globodera tabacum) on Fusarium Wilt of Connecticut Broadlfeaf Tobacco. Plant Disease 71:1129-1132.

10.019 CRIS0097011
ENVIRONMENTAL AND BIOLOGICAL STRESSES OF ROOTSTOCK IN PEACHTREE LONGEVITY.

SHERMAN W B; Fruit Crops; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-FRC-02529 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Elucidate causes of peach tree short life and predisposing factors which affect tree longevity and physiology.

Approach: Continue to evaluate tree longevity of three peach selections to Meloidogyne incognita (Race 3), which is able to attack 'Nemaguard' and other resistant rootstocks.

Progress: 87/10 to 88/09. Open pollinated seedlings of 2 rootstock selections, Fla. 14-11 and Fla. 9-4, continue to show homogeneous field resistance to root-knot nematodes Meloidgyne javanica and M. incognita Races land 3. One similar rootstock selection, Fla. 14-25, was discarded as about 1/4 of its seedlings showed visual reproductive root-knot galls. Seedlings of Fla. 14-11 and Fla. 9-4 have shown no visual signs of graft incompatibility in more than 50 scion combinations after 6 years in the field. Test results from several subtropical countries have reported no galling on Fla. 14-11 and Fla. 9-4 seedlings.

Publications: 87/10 to 88/09

SHERMAN, W.B. 1987. Planting and growth patterns of Florida peaches. p. 82-84. In: I. Skinner (ed.). Proc. 1st Nat. Low-chill Stonefruit Conf. Exotic Fruit Growers Assn., Lismore, Australia.

10.020 CRIS0097010
ENVIRONMENTAL AND BIOLOGICAL STRESSES OF ROOTSTOCK IN PEACH TREE LONGEVITY

ALDRICH J H; GOULD A B; Agr Res Cntr; University of Florida, Monticello, **FLORIDA** 32344.
Proj. No.: FLA-MON-02529 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Elucidate causes of peach tree short life and predisposing factors which affect tree longevity and physiology.

Approach: Continue to evaluate tree longevity of three peach selections to Meloidogyne incognita (Race 3), which is able to attack 'Nemaguard' and other resistant rootstocks.

Progress: 87/10 to 88/09. Phony peach disease (PPD) caused by the bacterium Xylella fastidiosa, is transmitted by the leafhopper vector Homalodisca coagulata. Symptoms of PPD include: shortened internode length, advancement of bloom date, and a steady decline of yield. PPD is unknown in Brazil, even though U.S. scion material is budded to Brazilian rootstocks. The effect of rootstock on PPD susceptibility was assessed in three plantings at Monticello, FL. In on planting, peach trees with 'Flordaking' budded to 'A-82' (a Brazilian rootstock), 'Nemaguard' (an industry standard), and '1-1' (a plum rootstock) were observed from May to September for the presence of leafhoppers. Rootstock influence on scion xylem sap amino and organic acid content were quantified to determine a possible basis for leafhopper preference. Tree growth, fruiting, and nematode susceptibility were evaluated. In two additional plantings (four difference scions budded to 'A-82' and 'Nemaguard' rootstocks, and two plum and two peach scions double-budded to 'A-82', 'Nemaguard', and 'Lovell' rootstocks), leafhopper presence and tree growth were evaluated. Leafhopper preference and total amino acid concentration were lowest on trees budded to the 'A-82' rootstock and highest on those budded to '1-1'. Growth parameters were not significantly influenced by rootstock.

Publications: 87/10 to 88/09
NO PUBLICATIONS REPORTED THIS PERIOD.

10.021 CRIS0142943
PEACH TREE SHORT LIFE AS RELATED TO FUNDAMENTALS OF TREE PHYSIOLOGY

NYCZEPIR A P; Agricultural Research Service, Byron, **GEORGIA** 31008.
Proj. No.: 6606-24000-004-00D
Project Type: INHOUSE
Agency ID: ARS Period: 04 JUN 88 to 04 JUN 90

Objectives: (1) To qualify levels of endogenous phytohormones (ABA, CYK, GAs, and IAA) and biochemicals (selected amino acids, polyols, and phenolics) from root, shoot and leaf tissues, (2) to monitor single intact leaf gas exchange activities and chlorophyll contents of peach trees under the greenhouse andthe field conditions, and (3) to determine the influence of the ring nematode on phytohormones, biochemicals and gas exchanges relative to peachtree survival.

Approach: Chlorophyll content and GEA of single intact leaves of peach trees will be monitored at biweekly intervals from May to November. Another 12 leaves pertree will be harvested every month and levels of endogenous phytohormones Sabscisic acid (ABA), gibberellin (GA), indoleacetic acid (IAA), and cytokinins (CYK)+ will be quantified using ELISA microtechnique with monoclonal antibodies specific for phytohormone. Ring nematode population densities will be monitored every fall and spring. Electrical resistance ofcambial area of tree truck and scaffold limbs will be monitored monthly through the summer and fall months and weekly during January to March with a Shigometer in order to determine metabolic activities within tree trunks and limbs. Trunk bark and twig samples will be collected during fall and winter months to determine electrolytic conductance, ninhydrin reactivity, and levels of selected amino acids, polyols (sorbitol and manitol), and phenolic biochemicals to study their role in tree decline.

10.022 0145304
BIOL. CONTROL OF PECAN INSECTS USING EARLY LEGUMES, PREDATOR RELEASES AND APPLICATIONS OF NEMATODES

WOOD B W; NYCZEPIR A P; SMITH M T; Agricultural Research Service, Byron, **GEORGIA** 31008.
Proj. No.: 0500-00002-007-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 89 to 30 SEP 92

Objectives: Develop methods for the biological control of pecan insects using early legumes, predator and parasitic nematode releases.

Approach: (1) Develop alternative methods for control of pecan aphids, utilizing biological, cultural, and/or physical methods. Research will focus on the utilization and management of beneficial insects, mites, and microorganisms to attain economic control of the black, blackmargined and yellow pecan aphids. (2) Develop alternative controls for the other pecan pests that are compatible with aphid control. Currently, control of these pests with insecticide contributes to aphid outbreaks by the elimination of beneficial insect species. (3) Integrate these procedures into a management program scheme that will reduce overall pesticide use on pecans while improving control and maintaining yield and quality at current levels.

Progress: 89/10 to 89/12. This pilot test begins in January 1990 and is to develop alternative methods for control of pecan aphids, utilizing biological, cultural, and/or physical methods. The research will focus on the utilization and management of beneficial insects, mites, and microorganisms to attain economic control of the black, blackmargined and yellow pecan aphids. It is also to develop alternative controls for the other pecan pests that are compatible with aphid control. Currently, the control of these pests with insecticide contributes to aphid outbreaks by the elimination of beneficial insect species.

Publications: 89/10 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

10.023 CRIS0140778
PEACH DECLINE AS RELATED TO DISEASES, NEMATODES, AND HOST PHYSIOLOGY

NYCZEPIR A P; PUSEY P L; Tree Fruit Prod & Protec Res SE Fruit & Tree Nut Res Lab; Agricultural Research Service, Byron, **GEORGIA** 31008.
Proj. No.: 6606-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 04 DEC 85 to 03 DEC 90

Objectives: 1) Develop basic understanding of nematode, disease & host tree relation- ships; 2) Identify altered metabolic pathways in trees; 3) Investigate disease, nematodes, etc. associated with short-life & decline problems; 4) Determine significance of gummosis & develop biol. control for brown rot ofstone fruit.

Approach: 1) Qualitate and quantitate parameters related to nematode feeding, soil fertility, and cold hardiness; 2) Determine the feeding habits of nematodesassociated with peaches and investigate the possibility of nematode- microorganisms interactions; 3) The interactions leading to cold injury will be investigated using newly developed techniques; 4) The disseminationof fungal gummosis will be determined using spore traps. The antagonist bacteria, Bacillus subtilis, will be evaluated as a biological control for brown rot.

Progress: 87/01 to 87/12. Cold injury (34%) and Clitocybe root rot (17%) remain the primary causes of tree death in screening rootstocks for survival on a short life (PTSL) site. Greenhouse screening for ring nematode C. xenoplax (Cx) resistance indicates that certain lines are either as good or better than Lovell (Lov). Root re-growth for dormant Nemaguard (Nem) & Lov trees was measured at 45, 50, 55, & 60 F. Growth rate was greater for Nem at all soil temperatures which could enhance Cx reproduction and tree susceptibility to PTSL. Leaf cytokinin and chlorophyll content were greater in 3-yr-old trees growing in Cx infested soil than in uninfested soil. Cx feeding delays leaf senescence in certain years, which could influence subsequent cold damage. Results indicate that improper cultural practices can make trees less dormant at a time of the year when cold injury occurs. Air and waterborne spore dispersal of Botryosphaeria fungi was monitored during a 3-yr period. Spores dispersed from diseased trees were predominantly B. dothidia and those from dead prunings were of B. obtusa. Four peach plantings were assayed for Prunus necrotic ringspot virus (PRSV) to assess its impact on tree performance as related to PTSL. PRSV affected tree growth, gummosis, cambial browning, bark splitting, root suckering, and fruit yield.

Publications: 87/01 to 87/12
NYCZEPIR, A.P., REILLY, C.C., and OKIE, W.R. 1987. Effect of initial population density of Criconemella xenoplax on reducing sugars, free amino acids and survival of peach seedlings over time. J. Nematol. 19:296-303.
JAFFEE, B.A., NYCZEPIR, A.P., and GOLDEN, A.M. 1987. Criconemella spp. in Pennsylvania peach orchards with morphological observations of C. curvata and C. ornata. J. Nematol. 19:420-423.
PUSEY, P.L. et al. Pilot tests for commercial production and application of Bacillus subtilis (B-3) for postharvest control of peach brown rot. Plant Dis. (Accepted 11/18/87).
PUSEY, P.L. Effect of water stress on susceptibility of nonwounded peach trees to Botryosphaeria dothidea. Proc. 3rd Stone Fruit Decline Workshop, (Accepted 5/26/87).
WILSON, C.L., FRANKLIN, J.D. and PUSEY, P.L. 1987. Biological control of Rhizopus rot of peach with Enterobacter cloacae. Phytopathology 71:316-319.
McSORLEY, R. et al. 1987. Bibliography of estimated crop losses in the United States due to plant-parasitic nematodes. Annals of Applied Nematol. 1:6-12.
GUELDNER, R.C. et al. Isolation and identification of Iturins as antifungal peptides in biological control of peach brown rot with Bacillus subtilis. J. Agr. Food Chem. (Accepted 10/23/87).

10.024 CRIS0140779
INSECTS OF PECANS AND OTHER TREE NUTS IN THE UNITED STATES

PAYNE J A; SNDW J W; TEDDERS W L; Tree Fruit Prod & Protec Res SE Fruit & Tree Nut Res Lab; Agricultural Research Service, Byron, **GEORGIA** 31008.
Proj. No.: 6606-24000-002-00D
Project Type: INHDUSE
Agency ID: ARS Period: 04 DEC 85 to 03 DEC 90

Objectives: Develop and improve pest control strategies for insects and mites limiting nut production with emphasis on maintaining high quality nuts without sacrificing yield while reducing resource consumption and pollution to the environment.

Approach: 1) Develop basic information on the biology of key insect and mite pests ofpecans and other tree nut crops; 2) Develop techniques for rearing nut pests and their parasites for use in developing pheromones, attractants, insect traps and for evaluating biological control agents; 3) Develop information on biological control systems for pecan and other tree nut pests with emphasis on aphids and mites; 4) Improve methods of control through manipulation of cultural practices, cover crops, systemic insecti- cides, growth regulating pesticides, or other insecticides that are specific in their activity; 5) Develop integrated pest management systems for economic control of nut pests.

Progress: 87/01 to 87/12. Pecan trees were identified as providing an important habitat for imported fire ants where they feed on large amounts of honeydew produced by blackmargined aphids. Such honeydew is an important food source for fire ants. Ants were observed feeding to at least 9m heights in trees. Mowing in orchards induced major changes in the ratio of ants on the ground to those in the trees. Fire ants were found to be major predators in pecan trees of the larvae of green lacewings and syrphids flys, but had little effect on the eggs and first instar larvae of convergent lady beetles. This information is highly relevant to the development of effective biological control programs for pecan aphids. A mutualistic relationship between fire ants and the mealybug Dysmicoccus morrisoni was also documented. The three species of phloem feeding pecan aphids were studied and quantified in relation to their impact on tree energy reserves and yield. This information has provided a factual basis for justifying major changes in pecan pest programs. Encap. methyl parathion (4 lb AI/Acre) was effective against kernel-feeding hemipterans. Unfortunately this pesticide does not provide adequate control of blackmargined aphids, another important late season pest. Achievement of 70-80% control of pecan weevil larvae with the nematode, Steinernema feltiae, was attained in laboratory tests. Male specific compounds were isolated from Leptoglossus phyllopus by an airborne trapping technique and major components have been identified.

Publications: 87/01 to 87/12

TEDDERS, W.L. and WOOD, B.W. 1987. Field studies of three species of aphids on pecan: an important cage for collecting honeydew and glucose-equivalents contained in honeydew. J. Entomol. Sci. 22:23-28.
DUTCHER, J.D. and PAYNE, J.A. The impact of Carbofuran applied to pecan orchard soil on emerging pecan weevil adults and foliage feeding aphids and mites. J. Entomol. Sci. (Accepted 10/06/87).
TEDDERS, W.L. 1986. Biological control of pecan insects. Proceedings of Farm Chemical Workshop. Univ. of GA Coop. Ext. Service, pp 52-59.
SOLOMON, J.D. and PAYNE, J.A. 1986. A guide to the insect borers, pruners and girdlers of pecan and hickory. U. S. Forest Service General Technical Report 50-64, 31 pp.
RING, D.R., ELLIS, H.C. and PAYNE, J.A. 1987. A model for timing treatments for the pecan nut casebearer. Proc. S.E. Pecan Growers Assoc. 80:63-64.
RING, D.R., PAYNE, J.A. and SNDW, J.W. 1987. An integrated pest management program for pecans in Georgia: Second year. Proc. S.E. Pecan Growers Assoc. 80:79-83.
McVAY, J.R. and PAYNE, J.A. 1987. Pecan aphicides: Past, present and future. Proc. S.E. Pecan Growers Assoc. 80:95-103; and Proc. Western Pecan Conference 21:105-118.

10.025 CRIS0140780
SOIL AND NUTRIENT FACTORS TO IMPROVE PEACH AND PECAN CULTURE

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Proj. No.: 6606-12000-001-00D
Project Type: INHDUSE
Agency ID: ARS Period: 04 DEC 85 to 03 DEC 90

Objectives: Identify soil factors associated with replant and short-life problems of peaches and with irregular bearing in pecans. Investigate and modify soil chemical and physical characteristics to enhance favorable soil organisms and decrease soil borne pathogens.

Approach: Research will concentrate on pH induced changes in soil chemical propertiesand the effects of these changes on the availability and uptake of nutrients. Field studies to determine the effects of soil acidity on micronutrient uptake and on the Al to Ca and Mg ratios will be conducted. Plant induced changes in the pH of the soil rhizosphere will be determined in greenhouse studies. Interactions between parasite nematodes of peach and soil chemical properties will be determined in greenhouse and field studies. The effects of subsoil acidity on growth and productivity of mature pecan trees will be investigated and the effects of symbiotic mycorrhizae on pecan seedlings will be determined.

Progress: 87/01 to 87/12. Two long term field studies with peaches were continued in 1987. The first study is designed to determine the relative importance of predisposing factors

in the development of PTSL. Results show that winter pruned trees in fumigated soil on Lovell rootstock lead to decreased incidence of PTSL. Soil fumigation also increased tree size and fruit yield per tree. Thus, the combination of increased fruit yield and decreased tree death indicates that soil fumigation may be economically feasible under certain conditions. The second field study is to determine the effects of various trunk insulating material on cold hardiness and PTSL. Insulating material includes "armiflex" foam, Tree Guard, Reflextix, and paint. Effect of insulation on PTSL development has been inconclusive to date. Two greenhouse tests were repeated in 1987. The results from these test indicate that stunt nematode is of relatively minor importance in peach production but lesion and rootknot nematodes greatly decrease growth and nutrient uptake. Ring nematode also decreased growth. However, ring nematode infestations resulted in nutrient imbalances which may play a role in the physiological processes involved in PTSL. This data shows the relative importance of different nematode genera in limiting peach production.

Publications: 87/01 to 87/12

SHARPE, R.R., NYCZEPIR, A.P., and REILLY, C.C. Effect of nematodes on nutrient uptake in Lovell and Nemaguard peach seedlings. Proceeding of the 3rd Stone Fruit Decline Workshop, Clemson Univ., Clemson, SC, 1987. (Accepted 05/26/87).

REILLY, C.C., OKIE, W.R., NYCZEPIR, A.P., and SHARPE, R.R. Biochemical changes in peach trees associated with peachtree short life. Proceedings of the 3rd Stone Fruit Decline Wksp., Clemson U., Clemson, SC, 1987. (Accepted 05/26/87).

NYCZEPIR, A.P., REILLY, C.C., OKIE, W.R., and SHARPE, R.R. Comparative studies between Criconemella xenoplax and other plant-parasitic nematodes. Proc. 3rd Stone Fruit Decline Wksp., Clemson U., Clemson, SC, 1987. (Accepted 05/26/87)

REILLY, C.C., OKIE, W.R., and SHARPE, R.R. Physiological changes in peach trees as related to pruning date, trunk treatment and cold hardiness. Phytopathology. (Accepted 05/26/87). (Abstract).

10.026 CRIS0135108

MAXIMIZING THE UTILITY OF ENTOMOGENOUS PATHOGENS IN CROP PRODUCTION SYSTEMS

GARDNER W A; Entomology; University of Georgia, Griffin, **GEORGIA** 30223.
Proj. No.: GE001419 Project Type: HATCH
Agency ID: CSRS Period: 01 AUG 88 to 31 JUL 91

Objectives: Quantify the impact of agrichemicals, soil antagonists, and target pest movement patterns on the persistence, stability, and efficacy of entomogenous fungi and nematodes in selected soils; determine and analyze biotic and abiotic factors that regulate natural epizootics of entomopathogens; evaluate methods to enhance the activity of the bacterium Bacillus thuringiensis against polyphagous lipidopteran pests; screen and manipulate pathotypes of selected entomogenous fungi to yield isolates resistant to antagonistic agents.

Approach: Laboratory, greenhouse, and field studies will investigate the impact of herbicides and soil microorganisms on the survivorship of entomogenous fungi and nematodes. Beauveria bassiana, Steinernema, and Heterorhabditis will serve as models. Regression procedures will be used to define key factors governing epizootics of entomogenous fungi. Controlled laboratory and greenhouse studies will further delineate the role of environmental factors in their epizootiology. Dose/mortality responses, feeding inhibition, and foliage consumption will be measured in laboratory studies. Field trials of efficacy will follow. Repeated subculturing and induced mutagenesis will be utilized to select for increased resistance of B. bassiana to antagonistic herbicides.

10.027 CRIS0095604

VARIOUS APPROACHES TO THE CONTROL OF NEMATODES IN PECAN ORCHARDS

POWELL W M; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000868 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 85 to 31 DEC 86

Objectives: To evaluate the impact of changing pest management strategies on nematode problems in pecan, 2) to research nematode control strategies as a part of evolving pecan production packages, and 3) to search for and evaluate candidate nematicides for use in nematode control in pecans.

Approach: Investigate the effect of common and hairy vetch on populations of Meloidogyne species attacking pecan and the consequences of such effects, 2) investigate the suitability of fenamiphos against root-knot nematode problems on established pecan trees, and 3) evaluate the effectiveness of non-fumigant nematicides in the control of root-knot nematodes.

Progress: 85/07 to 86/12. Populations of Meloidogyne species were collected from infested pecan groves and increased on tomato plants in the greenhouse. Preliminary tests were run measuring the susceptibility of two different types of vetch to these populations. Results to the present reveal no significant resistance to the nematodes on the part of the vetch cultivars. Tests involving various application methods, rates and times were established in an infested grove near Matthews, Ga. The results of these tests will be analyzed early in 1987 for modification and/or repetition during the coming season. Candidate nematicides were tested in cotton plots at three locations across Georgia. Results of these tests are currently being evaluated with respect to suitability of the materials for use in field nematode control situations.

Publications: 85/07 to 86/12
NO PUBLICATIONS REPORTED THIS PERIOD.

10.028 0139667
DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

ZUCKERMAN B M; Plant Pathology; University of Massachusetts, Amherst, **MASSACHUSETTS** 01003.
Proj. No.: MAS00662 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes emphasizing biological and cultural control procedures.

Approach: The focus is on novel nematode biocontrol systems. First is the isolation of nematicidal repellent and/or reproduction inhibiting microbes from naturally nematode suppressive soils. Several organisms isolated thus far have successfully completed greenhouse trials and will be cooperatively field tested with project participants in New York (Abawi) and Connecticut (LaMondia). Second, is the further testing of nematode suppressive legumes. Work thus far has indicated that a lectin given off in root exudates from jackbean acts as a continuous delivery system to repel nematodes.

10.029 CRIS0028875
NEMATODE POPULATION MANAGEMENT IN MICHIGAN CROP PRODUCTION

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL00446 Project Type: STATE
Agency ID: SAES Period: 20 AUG 82 to 19 AUG 88

Objectives: To develop procedures for improved detection of nematodes (plant parasitic and beneficial) and diagnosis of nematode problems associated with selected fruit, vegetable and agronomic crop production systems. To develop procedures for improved production system analysis related to nematode problems; with special reference to nematode sampling and extraction and crop loss assessment. To design and validate integrated nematode management procedures using the principles of exclusion, population reduction and tolerance.

Approach: Most of the research associated with this project will deal with three model nematode species: Pratylenchus penetrans, Meloidogyne hapla and Heterodera schachtii. Xiphinema americanum, Longidorus breviannulatus, Criconemella xenoplax, Heterodera trifolii and Meloiodgyne nataliei will be investigated on a more limited basis. Field, greenhouse, growth chamber and laboratory experiments will be used to design improved nematode sampling, extraction and crop loss assessment procedures. A broad array of nematode control procedures will be validated under both field and controlled conditions.

Progress: 87/01 to 87/12. The 1987 research program concentrated on management of nematode problems of carrot, potato, cherry, sugarbeet, soybeans and corn. Heterodera glycines was discovered in Michigan for the first time, and the geographical isolate will attack dry beans. Implementation of previous chemigation research continue to be successful. In a jount MSU project with the Zimbabwe Ministry of Agriculture, maize roots and P. zeae were aggregated at depth 0-20 cm. P. zeae in this study had a Pf/Pi ratio of 170. Very few second stage juveniles were recovered in this study. The optimal time for sampling maize roots for P. zeae was 4 weeks after planting at depth 10-20 cm and radius of 0-10 cm. The optimal time for sampling soil around maize roots was 2 weeks after planting at depth 10-20 cm and radius 10-20 cm. Maize root growth was adversely impacted at 11.7% gravimetric soil moisture in loamy sand soil and P. zeae population density was only slightly adversely impacted at 5.0% gravimetric soil moisture in the greenhouse study. Carbofuran, fenamiphos, isazofos and terbufos reduced P. zeae in maize roots by 95, 96, 95 and 93% and increased yield by 67, 54, 37 and 66% respectively, and organic amendments reduced P. zeae and increased maize growth and grain yield.

Publications: 87/01 to 87/12
MACGUIDWIN, A.E., BIRD, G.W., HAYNES, D.L. and GAGE, S.H. 1987. Pathogenicity and population dynamics of Meloidogyne hapla associated with Allium cepa. Pl. Dis. 71:446-449.
MUCHENA, P.K. and BIRD, G.W. 1987. Role of fenamiphos as a nemastat for control of Heterodera schachtii in cabbage production. Pl. Dis. 71:552-554.
BURNETT, B. 1986. Effects of the oat cyst nematode on small grains in Michigan. M.S. Thesis. Crop and Soil Science Dept. MSU. E. Lansing. 63 pp.

10.030 0139915
DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

CHEN T A; MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11285 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes; emphasizing biological and cultural control procedures. Evaluate these tactics and integrate effective procedures into practical nematode management programs which minimize crop losses, environmental contamination, and human health risks.

Approach: Develop efficient and specific detection probes for the diagnosis and identify plant viruses transmitted by nematodev ectors. Biotechnology such as hybridoma techniques and gene probes will be used. Attempt to culture in vitro biological antagonists to nematodes, particularly Pastoria sp. The relationship of the nutritional value of plant roots to nematode production will be investigated. A model system consisting of varieties of Kentucky bluegrass or perennial ryegrass and Tylenchorhynchus maximus will be tested to establish if the nematode's reproduction is affected. Biochemical analyses will then be correlated with reproduction rate.

Publications: 87/01 to 87/12

COSTANTE, J.F., MAI, W.F., ALEDNG, J. and KLEIN, R.M. 1987. Effects of apple rootstocks and nematicides on Pratylenchus penetrans populations and apple tree growth. J. Amer. Soc. Hort. Sci. 112:441-444.

MAI, W.F. and ABAWI, G.S. 1987. Interactions among root-knot nematodes and Fusarium wilt fungi on host plants. Ann. Rev. Phytopathol. 25:317-338.

ZUCKERMAN, B.M., MAI, W.F. and HARRISDN, M.B. EDS. 1987. Plant nematology laboratory manual (in Spanish). Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

10.031 CRIS0060493
ECOLOGY AND CONTROL OF PLANT PARASITIC NEMATODES

MAI W F; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-153429 Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 82 to 31 DEC 87

Objectives: The overall objective is to develop and improve integrated control procedures for nematode diseases and complex root diseases caused by nematodes and othr osil organisms which will not result in harmful residues in food, be detrimental to the environment, or injure growers. More specific objectives are to when appropriate, determine distribution of plant-parasitic nematode species and pathotypes, to further study the etiology of complex diseases and interactions among the causal organisms and other factors, to determine damaging levels for nematode and complex diseases of fruits and vegetables and determine biological and abiotic factors influencing these levels.

Approach: Distribution of nematode species and pathotypes will be determined by surveys of growers' farms. Cost/benefit analyses of control strategies will be constructed using data from experiments on growers' farms. In cooperation with G.W. Bird, Michigan State and G.S. abawi. Geneva Agricultural Experiment Stateion a crop loss assessment model for Heterodera schachtii will be designed. Damaging and economic threshold levels for nematode and complex diseases will be determined in microplot experiments.

Progress: 87/01 to 87/12. The influence of maturity of cabbage at time of harvest on the effect of 3 initial inoculum levels (Pi's) of Heterodera schachtii (Hs) on total and marketable cabbage yields was studied in microplots. Harvests were made at 75, 90, and 105 days after harvest. Yield (total and marketable) reductions at all Pi's was reduced by delayed harvest. However, delaying harvest by up to 30 days did not result in complete recovery of infected plants. Ten, 20, and 40 eggs/cc soil reduced marketable yield by 34, 51, and 62% respectively, in the first harvest and only by 15, 23, and 36% at the last harvest 30 days later.

10.032 CRIS0096853
CONTROL OF APPLE UNION NECROSIS AND DECLINE THROUGH CROSS PROTECTION

GDNSALVES D; Plant Pathology; N Y Agricultural Expt Station, Geneva, **NEW YORK** 14456.
Proj. No.: NYG25325 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 85 to 31 DEC 88

Objectives: Determine the pathogenicity of the (potentially mild) Chickadee and the (severe) Winchester strains of tomato ringspot virus (TmRSV) to apple trees under greenhouse conditions and under orchard conditions in different geographic areas. Determine if the Chickadee strain does protect apple trees from infection by virulent strains of TmRSV and, therefore, does prevent apple union necrosis and decline (AUND) under different orchard conditions. Identify the factors which might affect cross protection ability of mild isolates using Nicotiana benthamiana as a model.

Approach: The proposed research involves the evaluation of a mild isolate (Chickadee) of TmRSV for cross protection on apple trees under greenhouse and field conditions. It also includes a detailed study of factors which influence the effectiveness of cross protection using N. benthamiana as a model.

Progress: 85/06 to 88/12. Cross protection effectiveness of a mild strain (Chicadee) of tomato ringspot virus (TmRSV) was evaluated in greenhouse and field conditions. Chicadee does not cause union necrosis in apples and is serologically distinct from other TmRSV strains. In greenhouse tests, Chicadee cross protected against a severe strain (PYBMV) of TmRSV in Nicotiana benthamiana. ELISA (enzyme-linked immunosorbent assay) was used to monitor each strain independently in the same plant. Data showed that cross protection (as judged by mild symptoms) occurred even in plants infected with both severe and mild strains. Field trials were started in 1984 with apples and peaches in New York (Geneva, Hudson Valley), West Virginia (Kearneysville), and Virginia (Winchester). Plants were inoculated with mild strain in 1984 and transplanted to the field in 1985. By 1987, the peach trial showed that 90 percent of the trees inoculated with severe strain alone were dead as opposed to 16 percent of the mild strain inoculated.

These data verified the severity and mildness of the TmRSV strains. Mild- and strain-infected peach trees were challenge inoculated in summer 1988. Apple trees were indexed for the severe and mild strains in 1988, and subsequently challenge inoculated in 1988. Plants inoculated in 1984 with the severe strain look healthy. Evaluation of the field trials will continue. In summary, cross protection field trials are well established, they have been challenged, a remain to be evaluated.

Publications: 85/06 to 88/12

BITTERLIN, M.W. 1986. Tomato ringspot virus: interaction with its nematode vector Ziphinema rivesi, studies on virus transmission to and detection in fruit trees, serological characterization, implications for cross protection.

BITTERLIN, M.W., GONSALVES, D., and SCORZA, R. 1987. Improved mechanical transmission of tomato ringspot virus to Prunus seedlings. Phytopathology 77:560-563.

BITTERLIN, M.W., and GONSALVES, D. 1987. Distribution of tomato ringspot virus in peach trees: Implications for viral detection. Plant Dis. 72:59- 63.

BITTERLIN, M.W., and GONSALVES, D. 1987. Spatial distributiion of Xiphinema rivesi and persistence of tomato ringspot virus and its vectors in soil. Plant Dis. 41:408-411.

BITTERLIN, M.W., and GONSALVES, D. 1988. Serological grouping of tomato ringspot virus isolates: Implications for diagnosis and cross protection. Phytopathology 78:278-285.

10.033 CRIS0070699

DAMAGE POTENTIAL AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC03546 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Elucidate damage potential of nematodes, especially variable races of Meloidogyne incognita (MI) and M. Arenaria; determine impact of environment on related damage to tobacco and soybean; characterize spatial and temporal populations of nematode; develop and evaluate control tactics; monitor nematode communities species changes; and integrate information on MI on soybean into a simulator.

Approach: Field and microplot experiments will focus on "determinants" involved in nematode-induced crop losses. Evaluate utility of "nematode hazard indices" and economic thresholds. Incorporate data on soybean responses to MI into "CIPM" model. Study biochemical basis of differential virulence and resistance to Meloidogyne spp. on tobacco and mechanisms of nematode suppression of nodulation on soybean. Use findings to improve sampling procedures for advisory purposes. Direct cooperative research toward improving control tactics.

Progress: 87/01 to 87/12. Meloidogyne arenaria (MA) caused more severe damage to peanuts than M. hapla in an interaction study in microplots. Populations of MA differed in their virulence on tobacco. This species, M. hapla, and M. javanica had slight to no effect on the activity of M. incognita (MI) on resistant tobacco. Greenhouse evaluations showed a number of "USDA" tobacco lines to have resistance to one or more of these nematodes. These four root-knot species were found to have differential sensitivity to certain nematicides. Moisture levels affected MI-induced gall development on tobacco as well as leaf growth. Young plants and feeder roots of older Asparagus were found to be susceptible to this nematode. Older roots of this host apparently are resistant to MI. Sphaeronema sasseri and Pratylenchus macrostylus were widespread on Fraser fir and red spruce in the Black Mountains, NC. Both nematode species have low temperature optima.

Publications: 87/01 to 87/12

BARKER, K. R. 1987. Effects of irrigation and cultivar on growth and yield response of tobacco to aldicarb. J. Nematol. 19:511 (Abstr.).

BARKER, K. R., and NOE, J. P. 1987. Establishing and using threshold population levels. In Vistas on Nematology, p.75-81. Veech, J.A., and D.W. Dickson (eds.). Society of Nematologists. E. O. Painter Printing Co., FL.

BARKER, K. R., and NOE, J. P. 1987. Techniques in quantitative nematology, p. 223-236 In Experimental techniques in plant disease epidemiology. Kranz, J., and J. Rotem, eds. Springer-Verlag Berlin. Heidelberg-New York.

BARKER, K. R., STARR, J. L., and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.

CABANILLAS, H. E. 1987. Factors influencing the efficacy of Paecilomyces lilacinus in biocontrol of Meloidogyne incognita on tomato. Ph.D. Thesis, NCSU, Raleigh, N.C. 208 p.

KO, M. P. P.-Y, HUANG, J.-S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83: 229-305.

SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

10.034 CRIS0088272

TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology.

Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Ouchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09

RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.

RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

10.035 CRIS0132029

MORPHOLOGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDOGYNIDAE

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

10.036 CRIS0066710

QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESSES

INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: ORE00199 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extraction methodology for nematode detection and assessment. Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determinations of management cost/efficiency functions to allow derivation of economic thresholds.

Approach: Efficiency of nematode extraction from different soil types in Oregon will be compared to between Baermann Funnel, with and without wet sieving, and sucrose centrifugation, with and without wet sieving. The optimum procedure(s) will be compared with elutriation with the help of Dr. Howard Ferris at U.C. Davis. Nematode population dynamics and crop losses to root-knot nematodes will be studied under different irrigation regimes at the Hermiston Experiment Station. Threshold levels for lesion nematodes on mint will be studied in microplot experiments at the Central Oregon Experiment Station. The effect of concommitant infection with Verticillium on these threshold levels will also be examined.

Progress: 87/01 to 87/12. Objective 1: Number of lesion nematodes recovered from Baermann extraction with plastic funnels averaged 15% less than that from glass funnels but this difference was not statistically significant. Objective 2: Soil populations of Meloidogyne chitwoodi second stage juveniles were less in microplots receiving greater than normal amounts of water and greater in microplots receiving less than normal irrigation than in check microplots receiving "normal" levels of water application. Percent

tuber infection and number of galls/tuber also decreased with increasing water application. Lesion nematode population growth was not affected by amount of water applied. Objective 3: Individual seed pieces of Russett Burbank Potato were planted (4-16-86) in five gallon microplots infested with 0, 1, 11, 107 or 1069 M. chitwoodi eggs/qt soil. Tubers harvested (9-2-86) from these plants grown under "normal" water application contained 18, 12, 32, 83 or 100% infection with M. chitwoodi respectively. Index of infection on a scale of 0 (no infection) to 6 (100+ gall/tuber) averaged 0.35, 0.25, 0.9, 2.6, and 4.5 respectively. First-year yield of Benton strawberries grown in five-gallon microplots infested with 0, 2,500, 5,000, 10,000 or 20,000 Pratylenchus penetrans averaged 711, 643, 647, 595 or 644 g berries/plant respectively.

Publications: 87/01 to 87/12

SCHROEDER, J.M. 1987. Population dynamics, distribution and control of nematodes in highbush blueberries. M.S. Thesis Oregon State Univ., Corvallis, OR. 97p.

SCHROEDER, J.M., INGHAM, R.E. and GARREN, R. 1987. Population dynamics and control of nematodes in highbush blueberries. Proceedings of the Oregon Horticultural Society 78:153-155.

INGHAM, R.E., SCHROEDER, J.M. and GARREN, R. 1987. Seasonal, vertical and horizontal distribution of plant parasitic nematodes in Oregon highbush blueberry. J. Nematol. 4:531.

10.037 CRIS0098620

IDENTIFICATION, BIOLOGY AND CONTROL OF NEMATODE PESTS IN OREGON AGRICULTURE

INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: OREO0261 Project Type: STATE
Agency IO: SAES Period: 01 JUN 86 to 31 MAY 91

Objectives: Monitor known nematode problems, as well as identify and evaluate potential new problems which may occur as the result of population increases, disease complexes with microbial pathogens or changes in management practices. Research new and existing chemical and management control measures and evaluate their efficacy and cost efficiency for various known nematode pests. Study the biology of plant disease complexes which include nematodes and microbial pathogens.

Approach: A current knowledge of nematode species affecting Oregon agriculture will be maintained by examining samples submitted to the Plant Clinic and by occasional surveys. Chemical control will be examined by treating research plots in growers' fields with new and existing nematicides. Chemicals will be screened for efficacy, phytotoxicity and plant residue. Management practices to be examined include crop rotation sequences and the effects of cover crops on nematode populations in perennial crops. Microplots containing either potatoes or mint will be inoculated with nematodes, Verticillium, both or neither pathogen. Plant growth and yield will be examined for evidence of interactions between the two pathogens.

Progress: 87/01 to 87/12. Vydate 2E at 1 lb ai/A, Mocap 6E at 3 or 6 lb/A and Mocap 10 G at 6 lb/A were evaluated for control of lesion and pin nematodes on peppermint. Treatments were applied on April 15 or 29 to compare efficacy of different treatment dates but nematode densities in almost all treatments were not significantly different between application dates. Soil populations of lesion nematodes on May 28 were significantly less in the Mocap 6E on April 29 treatment than in the control and all other treatments except Mocap 10G on April 29. At harvest (August 3), densities were lowest in the Mocap 6E on april 29 treatment but were only significantly less than densities in the Vydate treatments. On May 28, numbers of pin nematodes were significantly less in the Vydate and Mocap 10G treatments than in the control. However, on August 3 only the April 15 treatment of Vydate had significantly fewer nematodes that in the control. Nemacur 3 at 6 or 12 lb ai/A was evaluated for control of lesion nematodes on highbush blueberry. The 12 lb ai/A rate significantly reduced lesion nematode populations as compared to the nontreated control but densities were not significantly different from those treated with 6 lb ai/A. Post treatment densities in the 6 and 12 lb ai/A treatments averaged 55% and 5% of those in the nontreated control, respectively.

Publications: 87/01 to 87/12

KAROW, R.S. and INGHAM, R.E. 1986. Cereal cyst nematode (Heterodera avenae Woll.). OSU Crop Science Report, EXT/CRS 66, 5 p.

INGHAM, R.E. 1987. Root-knot nematodes--preventing a potential problem. Proceedings of the 1987 Oregon Potato Conference and Trade Show, pp. 51-55.

10.038 CRIS0094508

INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

BLOOM J R; JAFFEE B A; Plant Pathology; Pennsylvania State University, University Park, **PENNSYLVANIA** 16802.
Proj. No.: PEN02769 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Oevelop improved nematode sampling methodology and assay procedures for IPM programs; determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships; using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Cooperate in the sampling and extraction research, emphasizing the precision of population recovery in relation to nematode temporal dynamics and life cycle stages, in relation to apple and peach production. Oetermine influence of Xiphinema spp. and Hoplolaimus spp. on growth and cold hardiness

of peach trees. Determine role of orchard ground cover management systems on Xiphenema spp.

Progress: 87/01 to 87/12. Variable population levels of 'Xiphenema' 'americanum' were maintained under "Redskin" peach trees planted in 1984 in plots where dandelion numbers varied per tree. The relationship of nematode and dandelion populations to the incidence of Prunus stem pitting disease was established. No incidence of stem pitting was observed to date, indicating either an insufficient number of nematodes or dandelions was maintained for virus spread to occur or that insufficient time had elapsed to adequately assess the results. In a separate experiment, "Sunhigh" peach trees propagated from the mild strain of Prunus necrotic ring-spot (PNRSV) continued to produce no obvious symptoms by the summer of 1987. NRSV-infected "Sunhigh" trees propagated with the severe ringspot virus strain continued to show "shock" symptoms during the summer of 1987. These infected trees showed no dieback, canker development, or reduced tree trunk growth related to virus infection.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

10.039 CRIS0137309
VIRUS AND VIRUS-LIKE DISEASES OF WOODY, DECIDUOUS FRUIT CROPS

HALBRENDT J M; Plant Pathology; Pennsylvania State University, University Park, **PENNSYLVANIA** 16802.
Proj. No.: PEN03036 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 89 to 30 SEP 93

Objectives: Determine the manner and rate of spread of these agents. Determine the effects of these agents on the propagation, growth, longevity, fruit quality, and productivity of woody, deciduous fruit crops, and their incidence and commercial impact. Develop and implement appropriate control strategies for virus and virus-like diseases of woody, deciduous fruit crops.

Approach: Nematicides were used to establish orchard plots with high, moderate, and low populations of X. amer. TmRSV infected dandelions were transplanted around peach trees in the plots. TmRSV infection was determined by ELISA. Healthy peach trees were compared to peach trees inoculated with PNRSV and Cytospora canker, alone and in combination, for yearly growth, increase in canker size and yield. Two levels of weed control were employed on orchard plots naturally infested with X. amer. The plots had either apple, peach, or no fruit trees planted. Population dynamics of X. amer. were monitored to determine levels of increase or decrease under these conditions.

10.040 0139844
DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

HALBRENDT J M; Plant Pathology; Pennsylvania State University, University Park, **PENNSYLVANIA** 16802.
Proj. No.: PEN03091 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes emphasizing biological and cultural control procedures. Evaluate these tactics and integrate effective procedures into practical nematode management programs which minimize crop losses, environmental contamination, and human health risks.

Approach: Virus transmission will be studied in the orchard and greenhouse. Orchard studies will correlate the incidence of virus-infected trees with known levels of nematodes and virus-infected weeds. A greenhouse technique is being developed to evaluate transmission effeciency of single nematodes. Dot blot hybridization and ELISA techniques are being utilized to assay for TmRSV in tree fruit at different time intervals after natural infection. Soil amendments, ground covers and novel crops are being evaluated for ability to suppress dagger nematode populations. These data are compared to efficacy of commercial nematicides.

10.041 CRIS0096896
BIOLOGICAL CONTROL OF DAGGER NEMATODES IN APPLE ORCHARD SOIL

JAFFEE B A; Plant Pathology; Pennsylvania State University, University Park, **PENNSYLVANIA** 16802.
Proj. No.: PEN02832 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 85 to 31 DEC 86

Objectives: Determine if fungal parasites of dagger nematodes can suppress nematode population densities in greenhouse tests; determine if sublethal nematicide dosage predisposes the dagger nematode to attack by fungal parasites; determine if mechanical disturbance of soil presidposes the dagger nematode to attack by fungal parasites.

Approach: After treatment appropriate to the objective, nematodes will be extracted, counted, and examined for parasitism.

Progress: 85/06 to 86/12. Three experiments were conducted to determine if biological control of daggar nematodes occur in orchard soil or during the extraction process. Living Xiphinema americanum (Xa) and X. rivesi (Xr) extracted from soil samples and stored for 1-5 days at 4 or 20 C contained aseptate fungal hyphae. Cataenaria anguillulae (Cat),

Lagenidium caudatum (Lab), Aphanomyces sp. (Aph), and Leptolegnia sp. (Lep) were isolated into pure culture from infected nematodes. The pathogenicity of these zoosporic fungi was determined by incubating mixed freshly extracted Xa and Xr in 2% soil extract containing zoospores obtained from single-spore isolates.

Publications: 85/06 to 86/12

JAFFEE, B. A. 1986. Parasitism of Xiphinema rivesi and X. americanum by Zoosporic Fungi. J. of Nematology 18(1):87-93.

JAFFEE, B. A. 1986. Infection of Xiphinema spp. by Zoosporic Fungi During Baermann Funnel Extraction. J. of Nematology 18(4):614 (Abstr.).

10.042 CRIS0093137

FACTORS CONTRIBUTING TO AND CONTROL OF PEACH TREE SHORT LIFE IN SOUTH CAROLINA

LIGON J T; CARTER G E JR; COSTON D C; Agri Engineering; Clemson University, Clemson, **SOUTH CAROLINA** 29634.

Proj. No.: SCO1089 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 MAY 84 to 31 OCT 87

Objectives: Investigate plants antagonistic to C. Xenoplax. Identify rootstocks resistant to short life factors and develop hybridization techniques for breeding multiple disease-resistant rootstocks. Determine the influence of soil moisture conditions, pruning practices, and insect infestation on susceptibility of trees to short life. Make physiological stress measurements on trees propagated on various rootstocks, growing in soil infested with C. Xenoplax, hedged during the summer, and under different soil water management systems. Relate various management practices to rate of tree loss and orchard profitability.

Approach: An interdisciplinary group will build on previous work in pursuit of the project objectives on field sites and in laboratory settings.

Progress: 84/05 to 87/10. Death from cold injury was tabulated for 4 years among 4 cultivars of peach Prunus persica (L.) Batsch pruned in fall and winter. Trees were grown on an old peach site which was preplant fumigated with Telone II and postplant fumigated with DBCP, to control the ring nematode Criconemella xenoplax (Raski) Luc and Raski. Death among all cultivars pruned in Oct., Nov. or Dec. was 2-3 times greater than among the same cultivars pruned in Jan. or Feb. Risk of death was not associated with a minimum number of chill units or with the rate of chill unit accumulation in the fall. Among groundcover plants tested, Buckhorn plantain reduced ring nematode populations by 75%. However nematode numbers were still high enough to be injurious to peach trees. Simulation procedures were developed to model the water balance of non-irrigated and trickle-irrigated peach orchards on a Norfolk loamy sand. During the growing season, simulated values of total available water in the root zone were within 2.0 cm of measured field values over 95% of the days for non-irrigated trees and over 80% of the days for irrigated trees. Differing degrees of susceptibility to peach tree short life were observed in over 140 line of Prunus material, with several lines showing tolerance to ring nematode with no tree mortality. Seed were collected from the most promising lines, including plum as well as peach, and are being used in a second test as rootstocks for commercial cultivars.

Publications: 84/05 to 87/10

AJUZIE, I.S., BAUER, L. and RATHWELL, P. 1987. Economic guidelines for replacing peach orchards, S.C. Agr. Exp. Cir. 201, June 1987.

ARMSTRONG, C.F., LIGON, J.T. an MCLEOD, M.F. 1987. Automated system for detailed measurement of soil water potential profiles using watermark brand sensors. Proc. Intl. Conf. on Measurement of Soil and Plant Water Status, Vol. 1: 201-206.

ARMSTRONG, C.F. and LIGON, J.T. 1988. Water balance simulation procedures for non-irrigated trickle-irrigated peach trees. Transactions of ASAE (In Press).

ARMSTRON, C.F. and LIGON, J.T. 1988. Moisture uptake patterns of non-irrigated and trickle-irrigated peach roots. Transactions of ASAE (In Press).

LAWRENCE, J.E., CARTER, G.E., JR., and ZEHR, E.I. 1986. Effect of fall and winter pruning on peach tree survival. Proc. 3rd Stone Fruit Decline Workshop, Clemson, SC. October (In Press).

10.043 0137399

RFLP AND MOLECULAR ANALYSIS OF ROOT KNOT NEMATODES, NEMATODE INFECTED PLANTS AND PEACHES

ABBOTT A G; BILLARD R; LEWIS S A; Biological Sciences; Clemson University, Clemson, **SOUTH CAROLINA** 29634.

Proj. No.: SCO1310 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 89 to 31 DEC 92

Objectives: Generate DNA clones for the construction of RFLP (restriction fragment length polymorphism) maps in peach and for race identification in nematodes; cDNA clones of nematode infected plant tissue will be used to search for plant genes induced during giant cell formation.

Approach: Peach RFLP maps will be constructed using random genomic clones in pUC8 and polymorphisms detected in hybrid peach X almond crosses. Random clones of the nematode species M. ingognita will be screened for polymorphism in biotypes 1, 2, 3 and M. areneria biotypes 1 and 2. Cascade hybridization will identify clones unique to M. incognita infection of soybean tissue. These will be studied in the hypersensitive response.

10.044 CRIS0065797
ENVIRONMENTAL AND BIOLOGICAL STRESSES OF ROOTSTOCKS IN PEACH TREE LONGEVITY

REIGHARD G L; ZEHR E I; Horticulture; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC00100 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Elucidate causes of peach tree short life and predisposing factors which affect tree longivity and physiology. Develop methods for rapid screening or physiological superiority, propagation, and cataloging characteristics of rootstock for peach scions.

Approach: Maintain Prunus germplasm collection. Screen germplasm for resistance to Criconemella xenoplax using field plots and greenhouse tests. Screen germplasm for ease of propagation via hardwood cuttings. Determine genetics of nematode resistance. Develop in vitro screening techniques.

Progress: 87/01 to 87/12. Observing 143 exotic Prunus lines for peach tree short life has shown differing degrees of susceptibility among lines. Several lines have shown tolerance to ring nematode with no tree mortality. Seed has been collected from the best lines and will be used in a second test. This seed will be used as rootstock for commercial cultivars 'Springcrest' and 'Redhaven' and will be planted in a known short life site for further evaluation. Included in the second test will be several plum lines along with peaches. Hardwood cuttings from more than 400 potential rootstock lines were collected in the fall and are being tested for rooting ability. Greenhouse screening of approximately 150 cultivars for ring nematode resistance is in progress.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

10.045 CRIS0098409
BIOLOGICAL AND CHEMICAL CONTROL PRACTICES FOR NEMATODES AND DISEASES OF PEACH AND APPLE TREES

ZEHR E I; MILLER R W; AITKEN J B; Plant Pathology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01179 Project Type: HATCH
Agency ID: CSRS Period: 01 JUN 86 to 31 MAY 90

Objectives: Improvement of fungicidal control of foliar and fruit diseases on stone fruit and apple trees; improve chemical control of nematodes on peach trees; study host range of Criconemella xenoplax and the use of nonhosts to suppress nematode populations on peach; investigate nature of injury by C. xenoplax in peach roots; study epidemiology, life cycle, and control of Xanthomonas campestris pv. pruni and Monilinia fructicola on peach.

Approach: Fungicides and nematicides will be tested in small-scale plots in replicated, randomized experiments under prevailing weather conditions. New, improved methods for applying nematicides will focus on sweep shanks and other innovations to minimize nematicide escape into the aid. Nematode host range and suppression will be studied in the greenhouse and small field plots using single plant species for host range and mixed peach-nonhost plants for studying interactions. Behavior of other peach pathogens will be studied in laboratory, greenhouse, and small-scale field experiments.

Progress: 87/01 to 87/12. Several long-term experiments begun in previous years to test the host range of Criconemella xenoplax, interactions of certain nonhosts with peach and C. xenoplax, and the spread of benomyl-resistant Monilinia fructicola were continued in 1987. Many leguminous plants were found to be hosts for C. xenoplax. Among nonhosts only buckhorn plantain showed some suppressive activity, although in experiments still in progress camphorweed and nimblewill may be suppressive. Benomyl-resistant strains of M. fructicola did not persist and spread in a peach orchard as well as sensitive strains. C. xenoplax was found to increase susceptiblity of peach to Xanthomonas pruni. Temperature of 30°C was more favorable to X. pruni infection than was 24 C. In fungicide tests, only Baycor among the sterol-inhibiting fungicides controlled peach scab, but Folicur, PP 523, SDS 65311, and RH 7592 were effective for brown rot control. Sterol-inhibiting fungicides mixed with mancozeb were effective for broad-spectrum apple disease control.

Publications: 87/01 to 87/12
ZEHR, E.I., KIRBY, G.W. and FOSTER, D.H. 1987. Rates and formulations of Rovral fungicide for control of peach brown rot, 1986. Fung. & Nemat. Tests 42:42-43.
WHITTINGTON, D.P. and ZEHR, E.I. 1987. Evaluation of fungicides for control of peach scab and brown rot, 1986. Fung. & Nemat. Tests 42:45.
EAYRE, C.G., JAFFEE, B.A. and ZEHR, E.I. 1987. Suppression of Criconemella xenoplax by the nematophagous fungus Hirsutella rhossiliensis. Plant Dis. 71:832-834.

10.046 CRIS0130855
PHYSIOLOGICAL INDICATORS OF STRESS IN PEACH TREES AFFECTED BY PEACH TREE SHORT LIFE

CARTER G E JR; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01219 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 87 to 31 DEC 90

Objectives: To monitor indole acetic acid and abscisic acid in peach trees as it relates to environmental and biotic stress factors, to monitor ethylene content of peach tissue as it relates to environmental and biotic stress factors, to extract and characterize proteins from peach cultivars and to investigate the production of novel stress proteins, to attempt to correlate peach cultural practices with plant stress and peach tree short life.

Approach: Indole acetic acid and abscisic acid will be solvent-extracted from freeze-dreid peach wood prepared from various stress

treatments. Solvent-partitioning purification techniques will be modified for reverse-phase HPLC analysis of samples. ABA and LAA will be quantified by HPLC. Stressed or nonstressed peach tissue will be homogenized in methanol. The homogenate will be centrifuged and the supernatant evaporated to dryness. Residue will be redissolved and 1-amino-cyclopropane-1-carboxylic acid will be determined. Ethylene in gas samples will be quantified. Response of peaches to heat shock, pathogens, and nematodes will be monitored in terms of changes in protein synthesized, both qualitatively and quantitatively. Protein will be extracted from leaf tissue purified by filtration and centrifugation, and concentrated using centricon microconcentrator cells.

Progress: 87/02 to 87/12. Protein extracts from woody tissue of five peach (Prunus persica (L.) Batsch) rootstock cultivars were analyzed by isoelectric focusing on polyacrylamide gels. All detected proteins focused within the pH range 3.2-4.3 and were analyzed by densitometry. Each rootstock could be identified in the early spring by the presence of characteristic protein bands found at either end of the protein banding region. A method was developed for extraction and analysis of ACC and MACC from peach leaf tissue. Samples were collected at 4-wk intervals from May through October from peach trees in microplots containing either Criconemella xenoplax or no nematodes. Levels of ACC in leaves were higher in the first and last samples taken than in samples taken at the remainder of the sampling dates. MACC content was shown to increase linearly throughout the year with no significant differences noted between treatments. An in vitro system was tested for its adaptability for measuring ethylene production and was found to be suitable if plantlets are sealed for only up to 48 hr. Two methods of extracting plant proteins from leaf tissue were comparted and it was found that vacuum infiltration was more effective than grinding. Silver stain was found to be more effective for staining leaf proteins than was Coomassie Blue. Ten enzyme systems were analyzed for isozyme variation among leaf samples from 13 Prunus species and five F(1) hybrid crosses. Noted isozyme variations will be used as genetic markers.

Publications: 87/02 to 87/12

MAZZOLA, M. and CARTER, G.E., JR. 1987. Peach rootstock characterization by protein analysis. HortScience. (In press).

10.047 CRIS0096022

FACTORS CONTRIBUTING TO AND CONTROL OF PEACH TREE SHORT LIFE IN SC

CARTER G E JR; GORSUCH C; BAUER L L; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01152 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 85 to 31 AUG 88

Objectives: Develop field studies of biological agents and plant species that might suppress ring nematodes. Determine effects of summer hedging of peach trees on cold injury and phytohormone levels. Determine and develop models for water uptake and root development for trickle-irrigated and nonirrigated peach trees. Measure the effect of two-spotted spider mites of peach tree growth and development. Develop an economic impact model for peach orchard replacement. Evaluate phytohormones, proteins and ethylene as indicators of nematode-induced stress in peach trees.

Approach: An interdepartmental approach utilizing expertise of scientists from five departments will be taken in this project. Work on the objectives will build on results from previous phases of the work and will expand into new areas.

Progress: 87/01 to 87/12. A nondestructive assay for ring nematode (Criconemella xenoplax) resistance in Prunus was developed and implemented in 1987 to screen more than 1000 seedlings for resistance. Those judged to have potential for further investigation for resistance are undergoing additional testing and will be ready for field tests (if warranted) in 1988. Peach plantlets prepared by tissue culture have been maintained in growth chambers and assayed for stress ethylene in preliminary experiments for ethylene study. In field tests peach trees in microplots at two locations were monitored for ethylene for one year and found to change with time but not with C. xenoplax parasitism. Isozyme patterns for peach, plum, and nectarine (13 species and 5 F hybrids) showed striking differences and show this as a potential method for differentiating rootstocks and cultivars. In field tests with fenamiphos nematicide application through a drip system did not provide effective control.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

10.048 CRIS0131530

CONTROL OF PEACH TREE SHORT LIFE IN SOUTH CAROLINA

ZEHR E I; CARTER G E JR; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01229 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 MAY 87 to 30 APR 89

Objectives: Screen germplasm of peaches and related Prunus species for resistance to the ring nematode, Criconemella xenoplax. Improve peach orchard cover crops to reduce nematode populations and control soil erosion. Study ways to utilize chemical nematicides more effectively in the field through more efficient methods of application.

Approach: Prunus germplasm will be screened for resistance in greenhouse tests using seedlings or rooted cuttings. Germplasm that appears to have a measure of resistance will be planted in nematode-infested soil in the field to test longevity and suitability as rootstock material. Improvements in screening procedures for determining resistance will be studied and implemented. Nature of feeding effects on roots

will be assayed. Nonhost plants (herbaceous annuals and perennials) will be studied for suitability as ground cover and nematode suppression. Mechanism(s) of suppression will be studied. Drip irrigation will be studied for appropriateness in applying chemical nematicides.

Progress: 87/05 to 87/12. During this reporting period procedures were put in place to screen approximately 100 Prunus seedlings per month for resistance to the ring nematode, Criconemella xenoplax. Using the nondestructive assay technique developed earlier, some selections have advanced through the procedure to the point where more promising lines can be propagated for establisment in field tests in 1988. Among the lines having lowest mortality in field tests, six will be selected in 1988 for budding with commercial cultivars in a field test in 1988. Research to identify stress proteins related to bacterial spot susceptibility was initiated in 1987. C. xenoplax was found to increase susceptibility of 'Blake' cv. to bacterial spot. Among plants tested for suitability as orchard cover, buckhorn plantain was suppressive of C. xenoplax, and nimblewill and camphorweed might have some suppressive activity in tests still in progress.

Publications: 87/05 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

10.049 CRIS0134905
CONTROL OF PEACH TREE SHORT LIFE IN SOUTH CAROLINA

ZEHR E I; CARTER G E JR; REIGHARD G L; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01273 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 MAY 88 to 31 DEC 90

Objectives: Continue screening of Prunus germplasm for resistance to Criconemella xenoplax. Study interaction between Prunus necrotic ringspot virus and Criconemella xenoplax. Continue study of peach orchard ground cover plants for nematode suppression. Study biological agents as parasite of ring nematodes.

Approach: A screening program in the greenhouse for screening Prunus germplasm for resistance to C. xenoplax will be continued and expanded to approximately 300 plants per month. Plants that support low increases of nematodes populations through 3 repetitions are planted in nematode-infested soil in the field to check survival. Acquisition of Prunus necrotic ringspot virus from infected peach trees by C. xenoplax and potential for transmission to healthy plants is tested in the greenhouse and field plots. Impact of virus on fruit yield and tree survival in nematode-infested soil will be studied in field tests. Herbaceous plants that do not support C. xenoplax reproduction will be interplanted with peach in microplots and population responses will be monitored.

10.050 CRIS0094444
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

COSTANTE J F; Plant & Soil Sciences; University of Vermont, Burlington, **VERMONT** 05405.
Proj. No.: VT-PS-00400 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships.

Approach: Evaluate the role of population densities of Pratylenchus spp., Meloidogyne spp. and Xiphinema spp. on the health of economically significant apple and strawberry cultivars. Economic thresholds and impact on non-bearing trees and strawberry plants will be determined through field and greenhouse studies. Damage thresholds for P. penetrans associated with various apple rootstocks will also be identified. Evaluate the influence and cost-effectiveness of field-applied nematicides, biocides, and pesticides and cultural practices on apple and strawberry growth and yield.

Progress: 87/01 to 87/12. Third year results from this long-term study initiated in 1984, showed that P. penetrans root populations appear to be building up in the fumigated plots with 107 nematodes/g root tissue in Telone C-17 treatments. Although there are approximately twice as many nematodes present in roots growing in Vorlex treated soil (187/g root) vs. Nemacur and control plots (76 and 69/g root), tree performance (ave. 10 apples/tree in fumigated versus 7.3 in the control) does not seem to be significantly affected at this stage. Regarding tree growth the largest

Publications: 87/01 to 87/12
COSTANTE, J.F., MAI, W.F., ALEONG, J., and KLEIN, R.M. 1987. Effects of apple rootstocks and nematicides on Pratylenchus penetrans and apple tree growth. J. Amer. Soc. Hort. Sci. 112(3):441-444.

10.051 CRIS0075865
VIRUS AND VIRUS-LIKE DISEASES OF WOODY, DECIDUOUS FRUIT CROPS

YODER K S; TOLIN S A; Winchester Research Lab., Winchester, **VIRGINIA** 22601.
Proj. No.: VA-136068 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Isolate, purify, characterize, and identify the causal agents of virus and virus-like diseases of woody, deciduous fruit crops. Develop improved methods for the detection and diagnosis of these agents. Determine the effects of these agents of the propagation, growth, longevity, fruit quality, and productivity of woody, deciduous fruit crops, and their incidence and commercial impact. Develop and implement appropriate control strategies for virus and virus-like diseases of woody, deciduous fruit crops.

Approach: Two apple cultivars grafted on three rootstocks, inoculated with latent viruses and planted in a randomized block design will be indexed for the viruses and surveyed for tree vigor. Trees inoculated with a mild TMRSV isolate and challenged with a severe TMRSV isolate will be observed for evidence of cross protection. Compare TMRSV isolates from grapes, apple, and weeds, and determine effects on grape rootstocks and certain vinefera varieties. Improve techniques for detecting TMRSV and other viruses in grape for use in virus-free certification of nursery stock.

Progress: 87/01 to 88/09. In a continuing study of the effect of three latent apple viruses on vigor and yield of Golden Delicious and Starking Delicious trees propagated from IR-2 materials and planted in 1972 fewer significant (P = 0.05) effects have been noted on surviving trees than in previous years. In comparison to uninoculated trees, stem-grooving virus (SGV) and mild stem-pitting virus (SPV) have reduced vigor of Golden Delicious/MM.106. Necrosis is evident in graft unions of most of the Starking Delicious/MM.106 trees inoculated with SGV, SPV, chlorotic leaf spot virus, mild SPV and in uninoculated trees. The presence of tomato ring spot virus has been confirmed in rootsprouts or rootstock bark of most of these trees by ELISA. Apple graft union necrosis has been detected in at least 20 orchards with tree losses totalling at least 250 acres. Stem-pitting remains a serious cause of peach and nectarine tree loss in Virginia. Stem-pitting symptoms were observed in some peach trees growing from rooted cuttings indicating that at least in some cultivars the graft union is not essential to symptom development.

Publications: 87/01 to 88/09

YODER, K. .S.. and COCHRAN II, A. E.. and WARREN, J. R.. and SCHMIDT, C. M.. and VANN, M. A., 1988, Evaluation of Terramycin for control of peach yellows, 1986-87., Fungicide-Nematicide Tests 43:75

10.052 CRIS0136322

VIRUS AND VIRUS-LIKE DISEASES OF WOODY, DECIDUOUS FRUIT CROPS

YODER K S; TOLIN S A; Winchester Research Lab., Winchester, **VIRGINIA** 22601.
Proj. No.: VA-136068 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Isolate, purify, characterize, and identify the causal agents of virus and virus-like diseases of woody, deciduous fruit crops. Develop improved methods for the detection and diagnosis of these agents. Determine the effects of these agents on the propagation, growth, longevity, fruit quality, and productivity of woody, deciduous fruit crops, and their incidence and commercial impact. Develop and implement appropriate control strategies for virus and virus-like diseases of woody, deciduous fruit crops.

Approach: Two apple cultivars grafted on three rootstocks, inoculated with latent viruses and planted in a randomized block design will be indexed for the viruses and surveyed for tree vigor. Trees inoculated with a mild TMRSV isolate and challenged with a severe TMRSV isolate will be observed for evidence of cross protection. Compare TMRSV isolates from grapes, apple, and weeds, and determine effects on grape rootstocks and certain vinefera varieties. Improve techniques for detecting TMRSV and other viruses in grape for use in virus-free certification of nursery stock.

10.053 CRIS0094412

BIOLOGY AND CONTROL OF ARTHROPOD PESTS OF BERRY CROPS

SHANKS C H JR; DOSS R P; MOORE P; Entomology; Washington State University, Vancouver, **WASHINGTON** 98665.
Proj. No.: WNP01957 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 86 to 31 MAR 91

Objectives: Identify, breed, and select strawberries resistant to insect and mite pests. Study the mechanisms of strawberry resistance to insect and mite pests. Develop chemical and biological controls for berry pests.

Approach: Both wild and cultivated strawberries will be tested for resistance to strawberry pests. Resistant clones will be used in the breeding program. Resistant seedlings will be evaluated for vigor and fruit quality to determine their potential as cultivars or for use as parents in further crosses. Resistance mechanisms (leaf pubescence, chemical feeding deterrents, tolerance, etc.) will be determined by appropriate methods. Chemical insecticides will be tested for efficacy in the laboratory and field. Efficacy, dosage, timing, residues on the harvested product, and effect on non-target organisms will be determined. The goal is to register efficacious insecticides on berry crops. Biological agents, e.g., insect-parasitic nematodes, will be tested for efficacy against larvae of soil inhabiting pests.

Progress: 87/01 to 87/12. Fragaria chiloensis clones resistant to strawberry aphid, Chaetosiphon fragaefolii, or black vine weevil, Otiorhynchus sulcatus, were crossed with clones of F. x ananassa. Of ca. 1100 seedlings bred for aphid resistance, 204 had < 25% of the aphid population on cv. 'Totem'. Of 342 seedlings bred for weevil resistance, 106 showed at least some resistance. When twospotted spider mite, Tetranychus urticae, were not controlled on greenhouse-grown strawberry plants, they reached 450 mites/leaflet and then declined to ca. five per leaflet. Sprayed plants were virtually mite-free. When new foliage was infested with mites, populations remained low on the first group but rose to 20 mites/leaflet before declining. Induced resistance may be the cause of this. Esfenvalerate was effective against

adult O. sulcatus. No other chemicals showed promise. The entomogenous nematodes Heterorhabditis heliothidis (two strains) and Neoplectana carpocapsae (All strain) were effective against O. sulcatus larvae in cranberry bogs. They were not effective against this pest in strawberry and raspberry fields, possibly due to low moisture at the soil surface. Tests indicated that daily sprinkling of the soil could increase nematode survival and soil penetration. Testing of the sex pheromone of the blackheaded fireworm, Rhopobata naevana, continued in cranberry bogs.

Publications: 87/01 to 87/12

CHAMBERLAIN, J.D., CHASE, D.L. and SHANKS, C.H., JR. 1987. An activity chamber and computerized data acquisition system for monitoring crawling insects. Ann. Entomol. Soc. Amer. 80:136-140.

DOSS, R.P., SHANKS, C.H., JR. The influence of leaf pubescence on the resistance of selected beach strawberry, Fragaria chiloensis (L.) Duchesne, clones to adult black vine weevils, Otiorhyncus sulcatus (F.). Scientia Hort. (In press).

SHANKS, C.H., JR. and CHAMBERLAIN, J.D. Effect of Taxus foliage and extract on the toxicity of some pyrethroid insecticides to adult black vine weevil (Coleoptera: Curculionidae). J. Econ. Entomol. 80 (In press).

SHANKS, C.H., JR. and DOSS, R.P. 1987. Feeding responses by adults of five species of weevils (Coleoptera: Curculionidae) to sucrose and sterols. Ann. Entomol. Soc. Am. 80:41-46.

10.054 CRIS0065796

DEVELOPMENT OF THE BASIC PARAMETERS FOR NEMATODE PEST MANAGEMENT DECISIONS

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.

Proj. No.: WNP00240 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extracting methodology for nematode detection and assessment; determination of the relationship between crop losses and nematodes as affected by environmental conditions; and determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: An in-depth sampling study in a center pivot irrigated potato field will be conducted to detect and assess Meloidogyne chitwoodi populations (eggs and juveniles). Factors to be investigated will include: number of subsamples/unit area; soil depth between 0-6'' time of sampling (weekly to monthly); soil type, and cropping sequence. Extraction procedures currently used in WA will be critically examined and compared to other methods to determine the most efficient extraction method and to quantify the level of efficiency. Population densities of M. chitwoodi and M. hapla will be manipulated by inoculation of cropping sequence in microplot and field trials to determine damage functins on several crops. Yield and/or quality of potato, carrots, beans and peas will be related to initial population densities of the nematodes. The influence of environmental conditions and control strategies (crop rotation, resistant varieties and pesticides) on damage functions will be determined.

Progress: 87/01 to 87/12. Reproductive factor (Pf/Pi) of Meloidogyne chitwoodi (MC) race 2 on 44 crop cultivars ranged from 0-130. Nonhost crops (R=0) included asparagus, cowpea, lima bean, peanut, spearmint, strawberry and a hydrid turnip. Reproductive efficiency of MC race 1 and 2 was also compared on selected crop cvs. Both races failed to increase on 9 onion cvs. (R=0=-0.2) and R values on 9 corn cvs. ranged from 0.8-16.9. Alfalfa cvs. Nevada Syn XX and W12SR2W1 exhibited high degree of resistance to M. hapla (MH) and MC races 1 and 2. Population of individual plants of Nevada Syn XX were 100, 90, and 91% resistant to MH, MC1 and MC2, respectively, and W12SR2W1 55, 100 and 65% resistant. In field microplot studies the damage threshold level of MH on Chantenay Red Cored and Orlando Gold carrot was estimated to be 16.7 and 5.6/250 CM soil, respectively. Damage level for MC races was >2000/250 cm soil. Vertical migration studies in columns buried in the field showed that MC was able to migrate upwards from depths of 60, 120 and 180 cm to infect tomato roots. MC eggs and juveniles placed at 60 cm infected tomato roots within 30 days, while those placed at 120 and 180 cm were detected in tomato roots after 60 days. A total of 1.5 and 3-acre-inches water applied in 8 days was able to move ethoprop down only 10 to 20 cm, respectively, in conceptrations to control MC. Ethoprop at 0.62 mu g/g was able to prevent invastion by MC. Ethoprop EC at 6.7 AI ka/ha protected the treated zone from migrating nematodes for 5 weeks.

Publications: 87/01 to 87/12

PINKERTON, J.N., MOJTEHEDI, H., and SANTO, G.S. 1987. Reproductive efficiency of Pacific Northwest isolates of Meloidogne chitwoodi on alfalfa. Plant Disease 71:345-348.

PINKERTON, J.N., MOJTAHEDI, H., SANTO, G.S. and O'BANNON, J.N. 1987. Vertical migration of Meloidogyne chitwoodi and M. hapla under controlled temperature. J. Nematol. 19:152-157.

MOJTAHEDI, H., SANTO, G.S. and WILSON, J.H. 1987. Host range of Meloidogyne chitwoodi race 2 (alfalfa race). J. Namatol. 19(4) (Abstr.)

MOJTAHEDI, H., PINKERTON, J.N., SANTO, G.S. and PEADEN, R.N. 1987. Reproductive efficiency on Meloidogne chitwoodi race 2 and its pathogenicity on alfalfa cultivars. J. Nematol. 10(4) (Abstr.).

10.055 CRIS0091352
PATHOGENICITY, BIOLOGY AND CONTROL OF ROOT-KNOT NEMATODES ON IRRIGATED CROPS IN WASHINGTON

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP00650 Project Type: HATCH
Agency ID: CSRS Period: 01 SEP 83 to 31 AUG 89

Objectives: Determine pathogenicity, damage and threshold levels; determine biology (population dynamics, vertical distribution, survival, migratory capabilities, life cycle, number of generations, host-parasite relationships, etc); and determine the efficacy of nematicides in relation to timing and application methods for controlling Meloidogyne chitwoodi and M. hapla.

Approach: Pathogenicity, biology and control studies will be conducted under controlled laboratory, greenhouse, field microplots, and/or natural field conditions. Naturally infested fields or pure root-knot nematode populations reared in the lab or greenhouse will be used to measure effects on plants. Soil used in tests will be free of other pathogens, except under natural field conditions. Experiments will be arranged in randomized block designs with 5 or more replicates. Experimental data to be collected will include measurements of crop yield and/or quality, plant growth, dry weight accumulation, nematode population dynamics in soil and plant tissue, and symptom expression. Environmental conditions including soil types, temperatures, moisture levels, length of growing season will be taken into account as they may affect the pathogenicity, biology and control of root-knot nematodes.

Progress: 87/01 to 87/12. Nematicide trials were conducted to evaluate chemicals for the control of Meloidogyne chitwoodi on potatoes. Treatmennts included fumigants and nonfumigants alone and in combinations; post-plant applications of non-fumigants to protect tubers at the time of nematode invasion; multiple applications of nonfumigants; and several application methods and rates were used to evaluate fumigants (Telone II, Vapam) and nonfumigants (Mocap, Nemacur, Temik, Vydate). Chemicals registered for use on potatoes as well as experimental compounds were evaluated. Excellent control was obtained with Telone II; fumigants in combination with Mocap; Mocap and Nemacur applied prior to planting and incorporated; and multiple post-plant applications of Mocap. Damage threshold studies show that M. hapla can reduce top growth of peppermint after two years at initial (Pi) inoculum levels of 500, 1,000, and 5,000 juveniles/250 cm soil. On Scotch spearmint growth reduction was observed at Pi of 5,000.

Publications: 87/01 to 87/12
SANTO, G.S., MOJTAEDI, H., PINKERTON, J.N. and WILSON, J.H. 1987. Biological control of root-knot nematodes on potato, 1987. Proc. of 26th Ann. Wash. State Potato Conf., pp. 57-59.

10.056 CRIS0082968
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

KOTCON J B; Plant & Soil Sciences; West Virginia University, Morgantown, **WEST VIRGINIA** 26506.
Proj. No.: WVA00287 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Apple and peak rootstocks in current and future collections will be evaluated for resistance to Xiphenema species, and for resistance to the tomato ring spot virus causing apple union necrosis and peach stem pitting transmitted by these nematode species. Nematicides for control of these virus-transmitting nematodes will be evaluated in the laboratory, greenhouse, and field for effectiveness in control, and for environmental safeness in fruit, soil, and ground water.

Progress: 87/01 to 87/12. Surveys of plant-parasitic nematodes in alfalfa, corn, potatoes, small grains, soybeans, and tobacco have been completed. Potentially damaging population densities of Meliodogyne hapla on alfalfa, Hoplolaimus galeatus on corn, Tylenchorhynchus spp. on tobacco, Pratylenchus spp. on alfalfa and on corn occurred in 10, 15, 43, 52, and 29% of the samples. Population dynamics of Xiphinema spp. in 15 peach orchardds were found to be quite variable. Overwintering mortality ranged from 6 to 95% of the November or December peak density. Nematicide applications reduced populations densities of Xiphinema, Pratylenchus, and Mononchus papillatus (a predaceous nematode) by 40 to 80%, 70 to 88%, and 44 to 51%, respectively, depending on the rate and application method used. Drip irrigation alone reduced nematode population densities significantly and drip irrigation applications of nematicide gave better control than standard broadcast sprays in the wetted area. Movement of the nematicide, phenamphos, through soil to groundwater is being monitored. Although high concentrations have been found 15 cm below drip emitters, no phenamiphos residues have been observed to date below 30 cm. Monitoring of phenamiphos movement, nematode population dynamics, and tree growth and mortality is continuing.

Publications: 87/01 to 87/12
KOTCON, J.B., LORIA, R. and WIXTED, D.J. 1987. Pratylenchus penetrans population dynamics on three potato cultivars. J. Nematol. 19:361:387.
FLORINI, D.A., LORIA, R. and KOTCON, J.B. 1987. Influence of edaphic factors and previous crop on Pratylenchus spp. population densities in potato. J. Nematol. 19:85-92.
KOTCON, J.B. and LORIA, R. 1987. Fall funigation of potatowith 1, 3-dichloropropene: Efficacy against Pratylenchus crenatus, yield response, and

groundwater contamination potential. Plant Dix. 71:1122-1124.
KOTCON, J.B. 1987. Association of soil type and texture with population density and distribution of Pratylenchus and Xiphinema species in peach orchards. J. Nematol. 19:536-537 (Abstr.).
WIXTED, D.J., LORIA, R., and KOTCON, J.B. Efficacy of ethoprop on potato and the potential for groundwater contamination. J. Nematol. 19:536-564 (Abstr.).

10.057 0139756

DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

KOTCON J B; Plant & Soil Sciences; West Virginia University, Morgantown, **WEST VIRGINIA** 26506.
Proj. No.: WVA00341 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes emphasizing biological and cultural control procedures. Evaluate these tactics and integrate effective procedures into practical nematode management programs which minimize crop losses, environmental contamination, and human health risks.

Approach: A bioassay to assess nematode biocontrol activity in soils will be used to quantify the effect of treatments on Pratylenchus spp. Long term nematode population dynamics and peach tree mortality will be monitored. Host resistance studies on apple and peach rootstocks to nematodes will be conducted. Attempts will be made to culture predaceous nematodes. The efficacy of chitin as a soil amendment for long term suppression of nematodes will be evaluated. Alternative methods for nematicide application will be studied to minimize negative impact on ground water. Marigold cover crops will be evaluated for nematode control.

11.001 CRIS0130704
INTEGRATED USE OF MICROBIAL & CHEMICAL NEMATICIDES FOR POTATOES IN TULELAKE

WESTERDAHL B B; JAFFEE B A; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*NEM-4795-SG
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 SEP 86 to 30 SEP 88

Objectives: With respect to the Columbia root knot (Meloidogyne chitwoodi) and lesion (Pratylenchus sp.) nematodes occurring in the Tulelake basin of California: determine if the Pratylenchus sp. is contributing to tuber blemishing and yield decreases. Determine nematode susceptibility to biological insecticides. Determine effectiveness of nematode microbial control agents and their compatibility with chemical nematicides. Assess toxicities of chemical nematicides to predators and pathogens of these nematodes. Isolate and identify pathogens of these nematodes.

Approach: Studies with utilize laboratory, greenhouse and field techniques.

Progress: 87/01 to 87/12. Each year, approximately 23,000 acres in the Tulelake Basin are utilized for the production of fresh market potatoes. The Columbia rootknot nematode, Meloidogyne chitwoodi, first became recognized as a pest in this basin in 1982. It has since been found to be widespread throughout the region. It causes significant yield reductions and significant numbers of blemished and unmarketable tubers. A second plant-parasitic nematode, Pratylenchus sp. which has been shown in other states to cause similar blemishes on tubers is also widespread in this region. Its possible role in tuber blemishing and yield reduction in this area has not been explored. This project has the following goals involving the integrated use of chemical nematicides and microbial control agents which are designed to develop knowledge to solve this pest complex problem in the Tulelake Basin. I. Determine if the pratylenchus sp. found in the Tulelake Basin is contributing to tuber blemishing and yield decreases. II. Determine if Columbia rootknot and Tulelake lesion nematodes are susceptible to microbial insecticides. III. Determine the effectiveness of nematode microbial control agents, their compatibility with chemical nematicides, and develop management strategies for integrated use of chemical and microbial nematicides. IV. Assess the relative toxicities of chemical nematicides to naturally occurring pathogens of plant-parasitic nematodes and develop management strategies to conserve and utilize these agents.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

11.002 CRIS0136927
INTEGRATED USE OF MICROBIAL AND CHEMICAL NEMATICIDES FOR POTATOES IN TULELAKE

WESTERDAHL B B; JAFFEE B A; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-5045-SG
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 SEP 88 to 30 SEP 89

Objectives: With respect to the Columbia root knot (Meloidogyne chitwoodi) and lesion (Pratylenchus sp.) nematodes occurring in the Tulelake basin of California: 1. Determine if the Pratylenchus sp. is contributing to tuber blemishing and yield decreases. 2. Determine nematode susceptibility to biological insecticides. 3. Determine compatibility of nematode microbial control agents with chemical nematicides. 4. Assess toxicities of chemical nematicides to naturally occurring nematode pathogens. 5. Screen soils from potato growing areas for nematode pathogens.

Approach: Studies will utilize laboratory, greenhouse and field techniques.

11.003 CRIS0131214
DEVELOPMENT OF BIOLOGICAL CONTROL AGENTS FOR THE EARLY DYING PEST COMPLEX

SCHROTH M N; Plant Pathology; University of California, Berkeley, **CALIFORNIA** 94720.
Proj. No.: CA-B*-PPA-4791-SG
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 SEP 86 to 30 SEP 88

Objectives: Determine the fungi and bacteria that interact with nematodes thereby affecting potato yields in semi-arid agroecosytems. Monitor colonization patterns of fungi that move from seed pieces to the progeny tubers.

Approach: Bacteria and fungi will be isolated from seed pieces. They will be tested for pathogenic activities to the developing stolons and progeny tubers in association with nematodes. Their populations will be monitored throughout the season to determine temporal-spatial relations.

Progress: 87/01 to 87/12. Analysis of three-dimensional models based on phenotypic profiles derived from nutritional tests enabled an assessment of the population composition of fluorescent pseudomonads in soil, and on potato plant parts. Great phenotypic diversity was detected among the 1430 strains with 114 of a possible 144 phenotypic profiles represented. Placement of the 65 predominant profiles in a three-dimensional similarity matrix revealed 15 phenon clusters. Only approximately 14% of the strains exhibited phenotypic profiles identical to named fluorescent pseudomonad strains. Distinct differences were detected in the composition of populations isolated at two field sites and among strains from non-rhizosphere soil and the rhizosphere.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

11.004 CRIS0136388
DEVELOPMENT OF BIOLOGICAL CONTROL AGENTS FOR THE EARLY DYING PEST COMPLEX

SCHROTH M N; Plant Pathology; University of California, Berkeley, **CALIFORNIA** 94720.
Proj. No.: CA-B*-PPA-5012-SG
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 88 to 31 AUG 89

Objectives: Determine characteristics of bacteria that colonize plant roots and have the potential to increase plant growth by reducing the incidence of fungal or nematode infections. This will enable the screening and selection of effective biocontrol agents.

Approach: Numerous known bacterial biocontrol agents will be examined for phenotypic characteristics in common compared to bacteria selected at random. Tests such as phosphorous solubilization, siderophore production and many others will be tested.

11.005 CRIS0134378
ASSESSING YIELD LOSS DUE TO CROP DAMAGE IN TERMS OF INTERCEPTED LIGHT

FERRANDINO F J; Plant Pathology & Ecology; Connecticut Agri Expt Station, New Haven, **CONNECTICUT** 06504.
Proj. No.: CONH00692 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 29 FEB 92

Objectives: Determine the relation between yield and crop damage caused by disease and insects by answering the questions: How is the total light energy intercepted by healthy leaves related to final yield for plants damaged by: diseases which cause rapid defoliation, diseases characterized by local lesions, wilt diseases, and insect herbivory? How is the net assimilation, dark respiration, and partitioning of photosynthate affected by disease and herbivory.

Approach: The relationships among the total plant dry weight, the dry weight of marketable yield and the total light intercepted by the plant over the growing season will be examined for several crop-pest systems including potato, defoliated by late blight and Colorado potato beetles, tomato affected by early blight, snap beans affected by bean rust, corn affected by corn rust, and tobacco attacked by nematodes. Yields from manually defoliated sections of control plots will be compared to the yields from areas sustaining damage by pests. Intercepted light will be measured using tube solarimeters. The severity of damage including fallen vegetation, will be measured. Final dry weight of the various organs of the plants will be determined and the quality of the final marketable product will be estimated. The rate of total dry weight increase per unit light energy intercepted will be estimated graphically from a plot of total plant dry weight versus total intercepted light.

11.006 CRIS0096068
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING VEGETABLE CROPS

WEINGARTNER D P; Agr Res Cntr; University of Florida, Hastings, **FLORIDA** 32045.
Proj. No.: FLA-HAS-02494 Project Type: STATE
Agency ID: SAES Period: 10 JUL 85 to 30 SEP 90

Objectives: a) Investigation of the biology and host-parasitic relationships of phytoparasitic nematodes associated with vegetable crops grown in Florida. b) Evaluation and development of management strategies designed to reduce economic losses due to nematodes attacking vegetable crops.

Approach: Effects of different nematicide combinations, cover crops and other management options on nematode control will be studied.

Progress: 87/10 to 88/09. At harvest population densities of Meloidogyne incognita observed during 1988 in potato research plots at Hastings were the greatest record here. Many plots had 4-6000 nematodes cm soil. The following nematicides applied in 38 x 8 M plots (( ) indicate rates ha in-the-row, 102 cm spacing): 1,3D (56 l applied using one chisel row), aldicarb 15G (3.36 kg) (A), metham sodium (187 l) applied using 2 chisels row) (MS), 1,3D + A, and MS + A resulted in respective Size A tuber yields of 21.4, 45.7, 38.6, 60.4, and 79.3% over those of nontreated controls. Increasing the rates of MS from 187 to 374 or 561 l ha failed to improved nematode control and yields of Size A tubers over those of the lowest rate.

Publications: 87/10 to 88/09
WEINGARTNER, D.P. and SHUMAKER, J.R. 1988. In row injection of metham sodium and other soil fumigants for control of nematodes and soil borne potato disease in Florida. Am. Pot. J. 65:504.

11.007 CRIS0142916
EPIDEMIOLOGY AND CONTROL OF POTATO EARLY DYING DISEASE IN MAINE

PAPAVIZAS G C; REEVES A; Plant & Soil Sciences; University of Maine, Presque Isle, **MAINE** 04769.
Proj. No.: 0500-21010-016-06S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 01 JUN 88 to 31 MAY 90

Objectives: Determine the role of plant parasitic nematodes and their interaction with Verticillium albo-atrum in the early dying disease complex; investigate theeffects of root lesion nematodes on Verticillium resistant selections available in Maine.

Approach: Small field plots will be infested with Pratylenchus penetrans alone, V. albo-atrum alone and with the two pathogens combined and compared for yields with uninfested plots to determine interactions on disease development; potato selections resistant to V. albo-atrum available in Maine will be tested in Verticillium-infested plots in the presence of P. penetrans to determine the stability of resistance.

11.008 CRIS0142904
EPIDEMIOLOGY AND CONTROL OF POTATO EARLY DYING DISEASE

PAPAVIZAS G C; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 0500-21010-016-02D
Project Type: INHOUSE
Agency ID: ARS Period: 01 MAY 88 to 30 APR 90

Objectives: Evaluate interactions of nematodes, bacteria, and other pathogens with Verticillium spp. in potato early dying disease; develop disease assessmentand prediction models; and develop innovative cultural, genetic, and biological control procedures for potato early dying.

Approach: Laboratory, greenhouse, and field studies will be performed to determine the role of root lesion nematodes, Pratylenchus, bacteria, Verticillium spp., and other fungi in the development of the potato early dying disease;to evaluate inoculum dose-response relationships to disease development andyield loss, and develop mathematical models to forecast potato growth and disease development; and to develop control technology including integrateddisease management systems, host resistance, and cultural and biological control procedures.

11.009 CRIS0074948
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL01306 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs. Determine the relationships among initial nematode population densities and crop yields, and impact of biotic and abiotic stresses on these relationships. Develop and validate predictive crop loss assessment systems. Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Laboratory, tissue culture, system science, growth chamber, greenhouse and field research procedures will be used to evaluate the associations between Pratylenchus penetrans and Solanum tubersum, and Heterodera schachtii and Brassica capitata relation to the four objectives of this project.

Progress: 87/01 to 87/12. During the past several years major research emphasis has been placed on the development of chemigation technology for use by Michigan potato growers. This has now expanded to the muck vegetable, strawberry and ornamental industries. In general on mineral soils, 25 gal/A of metham (sodium N methyl dithiocarbamate) will provide control of Pratylenchus penetrans; whereas, 40-60 gal/A is required for control of the early-die disease complex, and 75-100 gal/A for Verticillium dahliae control. In a three-year potato rotation, only the 100 gal/A rate kept populations of both P. penetrans and V. dahliae at low enough population densities to provide early-die control for a second potato crop. The Michigan geographical isolate of Herodera glycines reproduces on dry beans, and appears to be pathogenic. Heterodera carotae was recovered from 50% of the commercial fields and 19% of the samples in a western Michigan carrot survey. The biology of the MI geographical isolate appears to differ from that reported in the European literature. Meliodogyne nataliei can still be detected in isolated areas of the type location. The Michigan geographical isolate of Heterodera avenae is only mildly pathogenic on local oat and wheat cultivars.

Publications: 87/01 to 87/12

BIRD, G.W. 1987. Role of Nematology in Integrated Pest Management. pp. 114-121 (In) Vistas on Nematology, J. Veech and D. Dickinson (Eds). Society of Nematologists. 509 pp.
BIRD, G.W. 1987. Alternative futures of agricultural pest management. Amer. J. Alt. Agric. 2:25-29.

11.010 CRIS0096730
THREE MODELS FOR PREDICTING POTATO PLANT GROWTH AND TUBER YIELD IN NORTH-CENTRAL POTATO SYSTEMS

BIRD G W; GRAFIUS E J; TUMMALA R L; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL07528Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 85 to 30 JUN 89

Objectives: To describe and quantify the influence of selected pests (insects, fungi, weeds, and nematodes on potato plant growth and development, and tuber yield at five sites representing four NCR potato production systems. To evaluate three existing computer models for predicting potato plant growth and development and tuber yield from four sites representing five NCR potato production systems. To evaluate each model for its ability to be coupled with various pest submodels, and the ability of each coupled model to describe the effect of particular pests on potato growth and yield.

Approach: The research approach is to collect a standard set of biological and environmental data from five locations representing four specific potato production systems throughout the four states in the NCR. The data will be used to evaluate three existing potato models (WI-POTATO, MN-POTATO, and MI-POTATOPEST).

Progress: 87/01 to 87/12. The third and final year of Michigan field research data was collected during the summer of 1987 for validation of POTATO, SPUDGRO and POTATOPEST. POTATOPEST was successfully converted to MICROPOTATOPEST for operation on an IPM PC(AT) microcomputer. Using 1985 MI potato growth data for converting MICROPOTATOPEST to Russet Burbank, MICROPOTATOPEST was able to simulate 1987 potato yields for the MSU Montcalm research site. MICROPOTATOPEST simulations for Wisconsin, Minnesota and Wisconsin locations were less promising. Considerable time was spent in 1987 developing a root-lesion nematode subroutine for the new MSU potato model, SUBSTOR, new observations on the ontogeny of the potato root system, and the early infection of stolons by Pratylenchus penetrans were part of the 1987 program. Three publications are anticipated in 1988, including a description of MICROPOTATOPEST.

Publications: 87/01 to 87/12

BIRD, G.W. 1987. Multistate Potato Modeing Research Project. MI Potato Ind. News 26(4):8.

BIRD, G.W. 1987. Economics of Potato Early-Die Control. MI Potato Ind. News 26(4):16.

BIRD, G.W. 1987. Chemigation for Potato Early-Die Control. MI Potato Ind. News 26(4):16.

11.011 CRIS0142908

IDENTIFY SOURCES OF RESISTANCE AND ITS MANIPULATION TO CONTROL POTATO EARLY DYING

PAPAVIZAS G C; ANDERSON N A; LAUER F I; Plant Pathology; University of Minnesota, St Paul, **MINNESOTA** 55108.

Proj. No.: 0500-21010-016-09S Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 01 JUN 88 to 31 MAY 90

Objectives: Refine a Verticillium assay technique developed by the University of Minnesota and use it to assess the performance of resistant germ plasm in Verticillium-infested soils with and without high levels of parasitic nematodes; study inheritance of Verticillium wilt resistance in crosses using parents with varying levels of resistance.

Approach: Attempts will be made to redefine the Minnesota Verticillium assay technique in terms of host maturity using cultivars of known maturity as checks. Potato germ plasm will be tested in a Pratylenchus-infested plot atCambridge, MN and in a nematode-free plot in Red River Valley, North Dakota. Potato tubers will be infested at time of planting with V. dahliae and V. albo-atrum. Seventy highly resistant breeding lines will be tested at the Cambridge plot to determine whether these lines have resistance to both Verticillium spp. and nematodes. Field plots will also be established to test resistant parents and progeny of Verticillium resistant X Verticillium resistant parents and progeny of 12 Verticillium parents X five high gravity low sugar parents for resistance to early dying.

11.012 CRIS0094979

INTEGRATED PEST MANAGEMENT FOR POTATOES

JOHNSTON S; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.

Proj. No.: NJ11284 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Quantify biotic and abiotic factors which influence several specific pest-plant interactions. To develop and refine integrated pest management (IPF) strategies for potatoes, using models and system analysis techniques.

Approach: Field experiments will be conducted to develop IPM strategies for control of soil-borne diseases of potatoes. Cultural practices of fertilization application timing, vine defoliation and harvest timing will be varied to determine their influence on early dying and soft rot in the early maturing variety, Superior.

Progress: 87/01 to 87/12. Recently, there has been a declining use of aldicarb in potato fields. Since the reduction in aldicarb usage could result in an increase of plant parasitic nematodes, several fields of potatoes which were either treated with aldicarb or not treated were surveyed for population levels of plant parasitic nematodes. Results indicated a high level of Pratylenchus spp. present in the nontreated fields and low levels of nematodes in treated fields. Potato plants in fields with high levels of Pratylenchus spp. present also exhibited premature senescence. Verticillium dahliae was isolated from plants exhibiting these symptoms.

Publications: 87/01 to 87/12

JOHNSTON, S.A. 1987. Incidence of Pratylenchus spp. and Verticillium dahliae in potato fields not treated with aldicarb. Plant Pathology Bulletin 114 (In press). Rutgers-The State University.

11.013 CRIS0141468

BIOLOGY, ECOLOGY AND MANAGEMENT OF NEMATODE PARASITES OF POTATOES

BRODIE B B; Agricultural Research Service, Ithaca, **NEW YORK** 14853.

Proj. No.: 1907-22240-001-00D Project Type: INHOUSE
Agency ID: ARS Period: 04 APR 86 to 03 APR 91

Objectives: To develop and implement wide usage of golden nematode potato cultivars andto study nematode biology, ecology, and host resistance

relative to the manipulation and management of nematode population densities.

Approach: (1). Cooperate in the development of golden nematode resistant potato cul- tivars and test such cultivars in various crop management systems to maxi- mize efficacy in nematode control. (2). Identify physical and biological factors that govern nematode survivaland exploit vulnerable stages of survival mechanisms, e.g. host finding, start signals for entering and leaving survival states,distribution and movement of signals in soil, and source of signals. Incorporate new tech- nology into management schemes.

Progress: 87/01 to 87/12. Techniques were developed for aseptic culture of Globodera rostochiensis on potato plantlets, root cultures, and callus tissue. These techniques will enable more detailed studies of nematode behavior. Initial studies indicated that resistance in potato to G. rostochiensis is expressed in sterile culture. Repeated growing of resistant potatoes significantly reduced the ability of G. rostochiensis to develop on susceptible potatoes indicating that exposure to host resistance does not promote development of more aggressive races of the nematode. After 7 years of a resistant cultivar, the rate of population increase of G. rostochiensis on a susceptible cultivar was 10 times less than the increase of G. rostochiensis not exposed to a resistant cultivar. The frequency of host resistance required to manage G. rostochiensis at acceptable population levels was positively correlated with initial nematode density. At initial densities of <1 egg/cm3 of soil, alternate year cropping of a resistant cultivar managed the nematode at acceptable levels. Initial densities of 1-4 or 4-15 eggs/cm3 of soil required 2 successive years of a resistant cultivar or 2 years of resistance followed by a non host, respectively. Initial densities of >15 eggs/cm3 of soil required more than 2 years of resistance to successfully manage the nematode. Resistance to Meloidogyne chitwoodi and M. hapla was identified in potato clones derived from crosses of Solanum tuberosum ssp. andigena x S. tuberosum ssp. tuberosum.

Publications: 87/01 to 87/12

- CANTO-SAENZ, M. and BRODIE, B.B. 1987. Relation between morphology and parasitism in two populations of Meloidogyne incognita. J. Nematol. 19:19-22.
- CANTO-SAENZ, M. and BRODIE, B.B. 1987. Comparison of compatible and incompatible responses of potato to Meloidogyne incognita. J. Nematol. 19:218221.
- LAMONDIA, J.A. and BRODIE, B.B. 1987. Extraction of cyst nematodes from organic soils. J. Nematol. 19:104-107.
- BRODIE, B.B. and PLAISTED, R.L. 1987. Resistance in the potato cv. Highlat Russet to the golden nematode, Globodera rostochiensis. Amer. Potato J. 64:523-524.
- BRODIE, B.B. 1987. Population development of Globodera rostochiensis on susceptible potato following resistant potatoes. J. Nematol. 19:515-516.
- BRODIE, B.B. and PLAISTED, R.L. 1987. Resistance to Meloidogyne chitwoodi in potatoes. J. Nematol. 19:516.

11.014 CRIS0142036

PURIFICATION AND STRUCTURAL DETERMINATION OF THE GOLDEN NEMATODE HATCHING FACTOR I

BRODIE B B; RIOPEL J L; HECHT S; Agricultural Research Service, Ithaca, **NEW YORK** 14853.
Proj. No.: 1907-22240-001-03R
Project Type: INHOUSE
Agency ID: ARS Period: 01 MAR 87 to 28 FEB 89

Objectives: Purify and structurally analyze the natural golden nematode hatching factorfrom potato root diffusate.

Approach: From previously designed procedures using column chromatography the golden nematode hatching factor will be isolated from potato root diffusate. UsingHPLC the factor will be purified in sufficient quantities for structural determination. Reimbursable with APHIS - PPQ.

Progress: 87/01 to 87/12. Over the past year an isolation protocol was developed that resulted in the successful isolation of 10 micrograms of the golden nematode hatching stimulant. This amount proved insufficient for structural determination. However, the following analyses of the active factor were performed. 1) NMR - Four hour pulse yielded no usable data because of small amount of compound. 2) U.V. - spectra revealed no absorbance at wavelengths higher than 220 nm, suggesting that the compound is not aromatic or highly conjugated. 3) Mass Spectroscopy - the compound did not ionize well using electron impact mass spectroscopy, suggesting that part of the compound is very polar. It was concluded that structural determination will require a significantly greater amount of the active factor. Work is in progress to maximize the amount of active factor collected from potato root exudate and to enhance the efficiency of the isolation scheme. To that end, only young plants are being used for root exudate collections and the isolation protocol has been improved.

Publications: 87/01 to 87/12
ND PUBLICATIONS REPORTED THIS PERIOD.

11.015 CRIS0096863

SYSTEMS ANALYSIS FOR INTEGRATED MANAGEMENT OF FOUR MAJOR POTATO PESTS

WHITE G B; HAITH D A; Agri Economics; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-121577
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 85 to 31 DEC 87

Objectives: Initiate a systems analysis study to develop integrated management procedures for four major potato pests: Colorado potato beetle, late blight, early blight, and potato cyst nematode (golden nematode).

Approach: The preliminary systems analysis will have five major components: Develop a project statement. Select objective. Identify management strategies. Define the appropriate system. Evaluate and select appropriate models.

Progress: 87/01 to 87/12. Preliminary systems analysis for four major potato pests (Colorado potato beetle, golden Nematode, late blight, and early blight) was conducted. Potato growth models, pest models, pollution models, and decision models were reviewed for their applicability to develop management strategies for potato production. It was concluded that available models for plant growth, water pollution, and decision making are probably adequate for systems analysis of potato IPM. This is not true for pest models. For two of the four pests, Colorado potato beetle and early blight, the necessary models for prediction of plant damage could not be found. It is apparent that further modelling research for these pests is required before they can be included in a systems analysis of potato IPM.

Publications: 87/01 to 87/12

FARMER, G.S., WHITE, G.B. and HAITH, D.A. 1986. Systems analysis for integrated management of four major potato pests. Cornell A.E. Res. 86-26. 42p.

HAITH, D.A., FARMER, G.S. and WHITE, G.B. 1987. Models for systems analysis potato integrated pest management. Agricultural Systems. 24:183-197.

11.016 CRIS0049530

RESISTANCE TO EXOTIC RACES OF POTATO CYST NEMATODES

BRODIE B B; PLAISTED R L; Plant Breeding; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: 1907-22240-001-02S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 03 MAR 85 to 30 SEP 89

Objectives: To identify and characterize resistance to major races of potato cyst nematodes that do not yet occur in the USA and to incorporate this resistance into usable potato germplasm.

Approach: Accessions of Solanum spp. known or suspected to possess resistance to major races of potato cyst nematodes will be obtained from various potato germplasm collections throughout the world. Collections will be evaluated for resistance to Globodera rostochiensis race A at Ithaca, NY and for resistance to major races of G. pallida at the International Potato Center,Lima Peru. Resistant clones will be crossed to combine and/or enhance resistance. Progeny will be reevaluated in the USA and Peru. The most promising resistant clones will be used to incorporate resistance into the tetraploid condition. Evaluations for resistance to G. rostochiensis in thequality of resistance. When tetraploid breeding material with resistance tomajor races of potato cyst nematodes is established it will be available toany interested potato breeding program.

Progress: 87/01 to 87/12. Based on results of the 1985-86 evaluations for resistance to Globodera pallida races P4A and P5A, 44 clones resistant to one or both races were planted for use in crossing. Additional evaluations of these 44 clones revealed that 22 of them were also resistant to G. rostochiensis race R1A, the golden nematode. All of these clones, after screening for PSTV, were pollinated with bulk pollen from neotuberosum X tuberosum hybrids that were immune to PVX and PVY, resistant to the golden nematode and late blight, and were adapted to our long day growing conditions. Seeds of these crosses were planted in the spring producing about 1200 seedlings. Of these seedlings, 503 plants produced sufficient tubers to submit to Peru for evaluation for resistance to G. pallida P4A and P5A. These crosses should produce adapted potato clones with combined resistance to the 3 most widespread races of potato cyst nematodes, G. rostochiensis R1A and G. pallida P4A and P5A, as well as immunity to PVX and PVY and resistance to late blight.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

11.017 CRIS0049919

FARM-SCALE EVALUATION OF ADVANCED GOLDEN NEMATODE RESISTANT POTATO CLONES PRIOR TO VARIETY RELEASE

BRODIE B B; PLAISTED R L; Plant Breeding; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: 0500-21010-001-24S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 01 OCT 84 to 30 SEP 89

Objectives: Provide growers acceptable golden nematode resistant cultivars by detectingdeficiencies in potato clones prior to their release and to encourage grower adoption and widespread usage of new resistant cultivars thereby minimizing the risk of further spread of the golden nematode.

Approach: Contract with certified potato seed growers to produce one-half acre of the10 to 12 most promising golden nematode resistant potato clones from the project on accelerating the development and release of golden nematode resistant potato cultivars. Seed produced by the certified seed growers will be distributed to cooperating potato growers who will grow 1/2 to 1 acre of each clone under their farming systems and growing conditions. Cooperating growers will represent the major environmental, soils, and market conditions in the golden nematode regulated areas. Potato clones that survive the first year of farm-scale evaluations will be introduced tothe Foundation Seed Farm to develop nuclear disease-free seedstock for multiplication by foundation seed growers. Clones that survive 3 years of farm-scale evaluation will be released as cultivars.

Progress: 87/01 to 87/12. In 1987, 4 advanced golden nematode resistant clones NY71, NY72, NY79, and NY81 were in farm-scale evaluation. Three of these clones were planted in 10 trials by Anheuser-Bush and 4 by the Potato Chip and Snack Food Institute in 11 potato producing states outside the Eastern U.S. In addition, seeds of NY71 were distributed to 8 growers in New York, 4 growers in Pennsylvania, and 1 grower in North Carolina for farm-scale evaluation trials. Seeds of NY72

were distributed to 5 New York growers and 2 Florida growers for evaluations. Seeds of NY81 were distributed to 4 New York, 1 North Carolina, and 2 Florida growers for evaluations. Seeds of NY79 were distributed to 3 New York growers for evaluations. Based on the results of these farm-scale evaluations, NY71 will be released as a named variety within a year. NY72 will continue in farm-scale evaluation and subjected to fertility trials to alleviate late maturity in this clone. NY81 will undergo further evaluations and subjected to experiments for control of serious skin blemishes. Sufficient certified seeds of NY78, NY79, NY81, and two new advanced clones, D191-2 and D195-11, were produced under contract in 1987 for farm-scale evaluation trials in 1988.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

11.018 CRIS0062897
BREEDING POTATOES WITH BROADLY-BASED RESISTANCE TO THE CYST NEMATODE

ANDERSON R E; Plant Breeding & Biometry; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-149413 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 31 MAR 88

Objectives: To identify a select group of potato clones with proven resistance to race A of Globodera rostockiensis and races P4A and P5A of G. pallida. To add more diverse factors for resistance from recent introductions. To identify genetic factors for resistance and alternate forms of root tissue response to larval invasion. To convert the elite clones to commercially acceptable germ plasm for distribution to breeding programs.

Approach: Cumulative data through 1983 will identify a small and genetically diverse number of nematode resistant clones for continued conversion to adapted breeding lines. Newer materials will be added to this group as their resistance is established. The remaining sources of resistance will become a pooled composite against future needs and/or new races. Seedling populations will provide data for each component potato species on genetic factors for resistance.

Progress: 87/01 to 87/12. Data from testing of Cornell clonal material has shown that resistance to Globodera rostockiensis and/or Globodera pallida, species of the potato cyst nematode has been verified in accessions of 31 species of tuber-forming Solanum. Seventeen diploid species and 4 tetraploids have genetic factors for resistance to the more aggressive nematode species, G. pallida races P4A and P5A, on the basis of repetitive testing at the International Potato Center (CIP) in Peru. On this basis, 80 Cornell breeding lines have been designated as "elite" genetic material in the CIP breeding and distribution programs, and are thus becoming available to many breeding programs around the world. Successive generations of inter-specific crosses, each cross involving 2 to 6 species, have shown marked increases in the proportion of resistant progeny. This is evidence of several genetic factors for resistance, probably both multigenic and allelic forms. Thus there is now a broadly based clonal pool of germ plasm resistant to both species of potato cyst nematode. Breeding lines are being added as verified high levels of resistance in new accessions are found. New combinations of species are being hybridized to further diversify the available resistant germ plasm. Patterns of resistance indicate that 12 diploid species are very good sources of resistance. Clonal multiplication of lines insures availability of a range of resistant stocks.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

11.019 CRIS0135621
THE DEVELOPMENT OF POTATO VARIETIES ADAPTED TO EASTERN U.S.

PLAISTED R L; HALSETH D E; THURSTON H D; Plant Breeding & Biometry; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-149577
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 APR 88 to 31 MAR 89

Objectives: The development of potato varieties adapted to the Eastern U.S. for these markets: Long russets for tablestock and french fries, varieties with high specific gravity that can produce light colored potato chips late in the storage season. These varieties should be resistant to the golden nematode and scab.

Approach: The potato breeding program will produce new clones for the russet and chipping markets, screen for tuber and vine characteristics, processing quality, and yield at a limited number of locations in N.Y. Virus tested seed will be produced to meet the needs of each generation of selection. Advanced clones will be maintained in an in vitro collection. Clones will be evaluated for resistance to golden nematode and scab early in the selection process and later for other diseases. Advanced clones from N.Y. will be tested on Long Island and Upstate N.Y. along with new clones from other breeding programs. The most advanced clones will be evaluated under farm scale conditions, multiplied by foundation seed growers, and introduced to other trials throughout the eastern U.S.

11.020 CRIS0059109
STUDIES ON GOLDEN NEMATODE BIOLOGY, ECOLOGY, AND HOST RESISTANCE

BRODIE B B; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-153422 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 91

Objectives: To develop golden nematode resistant potato varieties with sufficient geographic adaptability, maturity dates, market

specifications and disease resistance for rapid acceptance and widespread usage by growers, to increase our understanding how biotic and abiotic factors influence nematode behavior, and to study host resistance relative to the manipulation and management of nematode populations.

Approach: Cooperate in the development of golden nematode resistant potato cultivars and test such cultivars in various crop management systems to maximize their efficacy in nematode control. Identify physical and biological factors that govern nematode survival and exploit vulnerable stages of survival mechanisms, e.g. host finding, signals for entering and leaving survival states, distribution and movement of signals in soil, and source of signals. Incorporate new technology into new golden nematode management schemes.

Progress: 87/01 to 87/12. Techniques were developed for aseptic culture of Globodera rostochiensis on potato plantlets, root cultures, and callus tissue. These techniques will enable more detailed studies of nematode behavior. Initial studies indicated that resistance in potato to G. rostochiensis is expressed in sterile culture. Repeated exposure of G. rostochiensis to resistant potatoes significantly reduced its ability to develop on susceptible potatoes indicating that host resistance does not promote development of more aggressive races of the nematode. After 7 years of a resistant cultivar, the rate of population increase of G. rostochiensis on a susceptible cultivar was 10 times less than increase of G. rostochiensis not exposed to a resistant cultivar. The frequency of host resistance required to manage G. rostochiensis at acceptable levels was positively correlated with initial nematode density. At initial densities of <1 egg/cm3 of soil, alternate year cropping of a resistant cultivar managed the nematode at acceptable levels. Initial densities of 1-4 or 4-15 eggs/cm3 of soil required 2 successive years of a resistant cultivar or 2 years of resistance followed by a non host, respectively. Initial densities of >15 eggs/cm3 of soil required more than 2 years of resistance followed by one year of a non host to successfully manage the nematode.

Publications: 87/01 to 87/12

CANTO-SAENZ, M. and BRODIE, B.B. 1987. Relation between morphology and parasitism in two populations of Meloidogyne incognita. J. Nematol. 19:19-22.

CANTO-SAENZ, M. and BRODIE, B.B. 1987. Comparison of compatible and incompatible responses of potato to Meloidogyne incognita. J. Nematol. 19:218-221.

LAMONOIA, J.A. and BROOIE, B.B. 1987. Extraction of cyst nematodes from organic soils. J. Nematol. 19:104-107.

BRODIE, B.B. and PLAISTEO, R.L. 1987. Resistance in the potato cv. Highlat Russet to the golden nematode, Globodera rostochiensis. Amer. Potato J. 64:523-524.

BROOIE, B.B. 1987. Population development of Globodera rostochiensis on susceptible potato following resistant potatoes. J. Nematol. 19:515-516.

BROOIE, B.B. and PLAISTED, R.L. 1987. Resistance to Meloidogyne chitwoodi in potatoes. J. Nematol. 19:516.

11.021 CRIS0049521

GOLDEN NEMATODE - ACCELERATED DEVELOPMENT OF RESISTANT CULTIVARS

BROOIE B B; PLAISTEO R L; JONES E O; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.

Proj. No.: 1907-22240-001-01S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 03 MAR 85 to 30 SEP 89

Objectives: To develop and release golden nematode resistant cultivars with sufficient geographic adaptability, market specifications, maturity dates, and diseaseresistance to encourage their rapid acceptance and widespread usage to control and confine the golden nematode.

Approach: Maintain the potato breeding program at a level of ca 100,000 new seedling clones per year. Maintain the capacity to process these clones through thevarious selection processes necessary to produce an acceptable cultivar. Expand plant pathological research activities in several areas essential toproducing acceptable cultivars including: 1) virus and viroid detection techniques, 2) meristem culture for maintenance of disease-free breeder's seed, and 3) evaluation methods for resistance to scab, Verticillium wilt, late blight, early blight, and viruses. Maintain the capacity for golden nematode resistance evaluations to meet the needs of an accelerated program. Increase the production of golden nematode resistant, disease- free nuclear seedstocks as necessary to meet the demands of an accelerated program.

Progress: 87/01 to 87/12. Over a half million seeds were planted from 20 crosses to produce chipping progenies, 12 crosses for russet types, and 1 cross for red skin tablestock. All segregate for golden nematode resistance. About 96,000 seedlings were transplanted producing about 41,000 new potential golden nematode resistant clones. The 68,000 single hills produced 8,817 first year chipping selections and 358 russet clones. The 15,000 second year observation plots produced 3282 clones with chipping potential. In the third generation, 901 chipping selections were reduced to 414 on the basis of golden nematode susceptibility and internal defects and 579 russet clones were reduced to 177. At harvest 99 of the former and 9 of the later were selected as new potential golden nematode resistant varieties. Extensive evaluations have resulted in 5 golden nematode resistant clones in the advanced stages of selection. Based on these evaluations, one advanced clone, NY71, will be released as a named variety this year. Results indicated that it will be a good golden nematode resistant alternative to the variety Monona. The advanced clone, NY81, continues to yield well but has a problem with skin blemishes. If this problem can be solved, NY81 will be a good golden nematode resistant

alternative to the early maturing variety Superior. Six new advanced golden nematode resistant clones resulted from 1987 evaluation trials and were introduced to the foundation seed farm for rapid seed multiplication.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

11.022 CRIS0014243
DEVELOPMENT OF PATHOGEN-FREE POTATO CLONES

JONES E D; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-153438 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 89

Objectives: To devise methods of regulating plantlet growth so that plants can be subcultured in vitro over a 3-4 week period but be ready to transplant (2-3" shoots with good roots) in a one week period. 2. To compare yielding ability of in vitro plantlets produced singly in glass culture tubes to those produced in multiple numbers in autoclavable polycarbonate/polypropylene vessels.

Approach: Two methods of regulating plantlet growth of three different varieties will be explored. (1) Alar-85 will be added to culture media at 2 different concentrations. Yields of treated plantlets will be compared to an untreated control. (2) Plantlets will then be grown at three different temperatures, one our current temperature of 70 (day) and 55 (night) as a known control, and 2 others: 65 and 50 , and 60 and 45 , respectively. B. Plantlet production in 25 x 150 mm glass culture tubes will be compared with production in 3" x 3" x 4" Magenta plant tissue culture vessels. Root and shoot development and tuber yields will be compared.

Progress: 85/01 to 85/12. In 1985, 3 new golden nematode (GN) resistant selections were processed in the Henry Uihlein II laboratory to eradicate pathogens and propogate for release. Of these, B-0033-23 and B-0032-35 are the first GN resistant red varieties. In 1985, 23 GN resistant varieties or promising selections were greenhouse grown for field increase in 1986. Preliminary tests in 1984 determined that Alar-85 would decrease plant height and increase tuber set in greenhouse grown plantlets. Two applications of Alar-85 (11.249 g/gal) 31 and 45 days after planting increased tuber set of Hudson plantlets from 7.7 to 10.7 (1 plantlet/pot and 11.7 to 14.6 (2 plantlet/pots). An expanded experiment was set up in the 1985 fall crop. Although data are not yet analyzed, it appears that timely application of Alar-85 decreases foliar height, increases tuber set and delays maturity. A replicated (6) non-irrigated field trial of the Hampton variety was repeated in 1985 to evaluate procedures for transplanting test-tube grown plantlets to fields. Yields (1 1/2 - 3 1/4") after 72 growing days were essentially the same for three treatments (single whole tubers, 168 cwt/A; plantlets in vermiculite plus Uihlein mix in the furrow, 166 cwt/A; plantlets in U. mix in 32 oz. cups, 160 cwt/A). Highest yield was obtained from plantlets in vermiculite plus U. mix in the furrow, 305.2 cwt/A. Plantlet nodal segments rooted in peat plugs gave much lower yields (1 1/2 - 3 1/4", 67 cwt/A; total, 74 cwt/A).

Publications: 85/01 to 85/12
JONES, E.D. 1985. Tissue culture as a tool for seed potato production. In: Proceedings of 1984 3rd Annual No. Amer. Seed Seminar. pp. 27-46. Nat. Potato Council Res. and Educ. Found. & Cert. Section of Potato Assoc. of America.

11.023 CRIS0084072
VEGETABLE DISEASE MANAGEMENT SYSTEMS FOR LONG ISLAND

LORIA R; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-153433 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: The overall objective of the project is to improve disease management practices through research on pathogen biology and ecology, yield loss relationships, and disease control options. Specific objectives are: Evaluate the variability of Streptomyces scabies and assess effects of edaphic factors and potato cultivar resistance on population dynamics and disease development. Investigate new methods for nematode management, particularly host tolerance, and evaluate the environmental impacts of currently available chemical controls.

Approach: Pathogenic S. scabies isolates will be evaluated in vitro for their response to pH, and classified based on spore color, melanin production, and formation of spore chains. Antibiotic resistant mutants will be used to monitor populations of S. scabies in soil and evaluate the effect of edaphic and host factors on population dynamics. The relationship of nematode tolerance to host water relations will be investigated utilizing techniques described in Wilcox and Loria (1985). Efficacy and potential for groundwater contamination by soil applied nematicides will be assessed as described in Loria et al. (1985).

Progress: 87/01 to 87/12. Potato cultivars and clones were evaluated for their relative resistance to common scab, caused by Streptomyces scabies. Of the seventy-two entries in the 1987 field study, the cultivar Superior was most resistant to scab, with a disease incidence of 4%. Nine entries had <20% tubers with scab lesions, including the cultivars NemaRus (8%), Norking Russett (11%) and Ontario (12%). The nematicide ethoprop was evaluated for control of Pratylenchus penetrans on potato and potential for groundwater pollution in Suffolk County, NY (Long Island) during 1987. Ethoprop, banded in the seed furrow at planting (3.4 kg/ha), significantly lowered P. penetrans population densities 45 days after planting and increased yields in plots planted to the potato cultivar Superior in two locations. Ethoprop migration through the soil profile after broadcast applications

(10.1 kg/ha) is also being evaluated at two Suffolk County locations. Concentrations of ethoprop in groundwater collected from shallow wells on the periphery of treated fields is also being determined. Pesticide residues will be monitored for up to one year after application.

Publications: 87/01 to 87/12

KOTCON, J.B., LORIA, R. and WIXTED, O.J. 1987. Influence of three potato cultivars on the population dynamics of Pratylenchus penetrans. J. Nematology 19:361-368.

KOTCON, J.B. Thesis. LORIA, R. 1987. Fall fumigation of potato with 1,3-dichloropropene: Efficacy against Pratylenchus crenatus, yield response, and potential for groundwater contamination. Plant Disease 71:1122-1124.

WILCOX-LEE, D. and LORIA, R. 1987. Effects of soil moisture and root knot nematode, Meloidogyne hapla (Chitwood), on water relations, growth, and yield in snap bean. J. Amer. Soc. Hort. Sci. 112:629-633.

WILCOX-LEE, D. and LORIA, R. 1987. Effects of nematode parasitism on plant water relations. Pages 260-266 in: Vistas on Nematology. Soc. of Nematologists.

FLORINI, D.A. 1987. Population densities of Pratylenchus penetrans and P. crenatus on potato and crops used in potato production systems. Ph.D. Thesis. Cornell Univ., Ithaca, NY. 116 p.

WIXTED, O.J., LORIA, R. and KOTCON, J.B. 1987. Efficacy of ethoprop on potato and the potential for groundwater contamination. J. Nematology 19:563-564 (Abstr.).

FLORINI, D.A. and LORIA, R. 1986. Changes in population densities of Pratylenchus penetrans and P. crenatus on winter cover crops. J. Nematology 18:607 (Abstr.).

11.024 CRIS0099425

ROOT LESION NEMATODE/VERTICILLIUM INTERACTIONS IN POTATO EARLY DYING DISEASE

REIDEL R M; ROWE R C; MADDEN L V; Plant Pathology; Ohio State University, Columbus, **OHIO** 43210.
Proj. No.: OH000404-SS Project Type: CRGO
Agency ID: CRGO Period: 01 AUG 86 to 30 NOV 88

Objectives: PROJ 8600204. To evaluate the ability of P. penetrans to break the expression of resistance to V. dahliae in a series of selected potato clones; to study the effect of P. penetrans on the interaction of P. crenatus and P. scribneri with V. dahliae in mixed nematode populations.

Approach: Field microplots will be located at two sites in soil pre-fumigated with methylbromide:chloropirrin (3:2). Microplot will be 25 x 30cm unglazed, clay, field tiles sunk to plow depth. Soil in the tiles will be infested with known populations of root-lesion nematode species from monoxenic alfalfa callus cultures, alone or in combination with various populations of axenically-produced V. dahliae microsclerotia. Each microplot will be planted with a presprouted seedpiece cut from pathogen-free tubers from tissue-cultured potato cultivars varying in resistance to V. dahliae. A completely randomized design with 15 replicate tiles per treatment will be used. Visual symptom data will be collected weekly to construct disease progress curves. Data collected at harvest will include soil and root populations of nematodes and fresh weights of tubers. Data will be analyzed by a factorial ANOVA.

Progress: 87/01 to 87/12. Field microplot trials were conducted to study the effects of simultaneous infection by various populations of root lesion nematode (Pratylenchus penetrans) and Verticillium dahliae on six potato clones varying in resistance levels to Verticillium dahliae. The aim of the study was to determine the potential of Pratylenchus to break host resistance to V. dahliae. Plots were designed with three levels of each pathogen individually and in all combinations with 15 replicate microplots of each treatment on each clone. Unfortunately, the plot was destroyed by a flood in early July. All clonal material is being reproduced to repeat the study in 1988. An additional study was conducted to examine the effects of mixed populations of P. penetrans and P. scribneri on development of the early dying syndrome on the potato cutivar Superior. Additional evidence was obtained to support the theory that low levels of P. penetrans can increase the ability of P. scribneri to interact with V. dahliae in causing the disease. P. scribneri, alone, is only mildly reactive with V. dahliae.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

11.025 0150038

DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

RIEDEL R M; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000977 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Ohio will participate in research directed toward Objective 1 of this program, ie., determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. In Ohio, this research objective will be met by studying Pratylenchus spp.-Verticillium dahliae interactions on potato (Solanum tuberosum).

Approach: Host potential of potato fungus will be tested using single female lines of P. penetrans, P. crenatus and P. scribneri. The ability of these three species to interact with V. dahliae on potato cultivars with resistance to V. dahliae will be tested with geographic isolates of each species derived from potato soil in the Northeast and Northcentral USA. Work will be performed in field microplots set in organic soil.

11.026 CRIS0034334
SYNERGISM BETWEEN ROOT LESION NEMATODE SPECIES AND VERTICILLIUM DAHLIAE ON POTATO

RIEOEL R M; ROWE R C; Plant Pathology; Ohio State University, Columbus, **OHIO** 43210.
Proj. No.: OH000383-SS Project Type: CRGO
Agency IO: CRGO Period: 01 SEP 84 to 31 OEC 87

Objectives: Our goal is to investigate the influence of species of Pratylenchus, soil type and host resistance on the interaction of root-lesion nematodes and Verticillium dahliae. We propose to 1) investigate the quantitative effects of soil type and host resistance on the synergism and 2) study mixed populations of P. penetrans, P. crenatus and P. scribneri as they interact with V. dahliae. Proj 8400028.

Approach: Data will be obtained using a field microplot system located at two sites in pre-fumigated soil. Oata collected will include soil and root populations of nematodes, fresh weights and quality evaluation of tubers, and fresh and dry weights of roots and shoots.

Progress: 84/01 to 87/12. Research completed during the life of this project as revealed the following about the complex disease, early dying of potato (Solanum tuberosum): 1) Potato early dying (PEO) occurs when Pratylenchus penetrans and Verticillium dahliae occupy simultaneously sand, silt-loam or peat soils--three major soil types devoted to potato production in Ohio; 2) PEO occurs in unfumigated, field soil when both organisms are present; 3) PEO losses in potato cannot be controlled by irrigation or increased nitrogen fertilization; 4) P. penetrans can break resistance of potato cultivar Tobique and B-8833-6; 5) low levels of P. penetrans can cause P. scribneri, a non-reactive species, to interact with V. dahliae and cause PEO.

Publications: 84/01 to 87/12

RIEDEL, R.M. and ROWE, R.C. 1985. Interaction of lesion nematode (Pratylenchus spp.) with Verticillium dahliae in potato early dying disease. Am. Potato J. 62:163-171.

RIEOEL, R.M. and ROWE, R.C. 1985. Oifferential interactions of Pratylenchus crenatus, P. penetrans and P. scribneri with Verticillium dahliae in potato early dying disease. Phytopathology 75:419-422.

ROWE, R.C., RIEOEL, R.M. and MARTIN, M.J. 1985. Synergistic interactions between Verticillium dahliae and Pratylenchus penetrans in potato early dying disease. Phytopathology 75:412-418.

ROWE, R.C. and RIEOEL, R.M. 1985. Nematode-Verticillium interactions in potato early dying under non-irrigated conditions. pp. 96-102. In: Proc. Third Ann. N. Am. Seed Potato Seminar. Chicago, IL. Nov. 29-30, 1984. 122 pp.

FRANCL, L.J., MAOOEN, L.V., ROWE, R.C. and RIEOEL, R.M. 1987. Potato yield loss prediction and discrimination using preplant population densities of Verticillium dahliae and Pratylenchus penetrans. Phytopathology 77:579-584.

FRANCL, L.J., ROWE, R.C., RIEOEL, R.M. and MAOOEN, L.V. 1988. Effect of three soil types on potato early dying disease and associated yield reduction. Phytopathology 77:159-166.

11.027 CRIS0095114
BIOLOGY AND CONTROL OF ROOT AND FOLIAR PATHOGENS OF FIELD VEGETABLES

ROWE R C; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000795 Project Type: HATCH
Agency IO: CSRS Period: 02 JUN 88 to 28 FEB 91

Objectives: Evaluate fungicides for foliar disease control on vegetable crops; evaluate antagonistic microorganisms as biocontrol agents of root pathogens of vegetable crops; develop a disease forecasting system for gummy stem blight of greenhouse cucumber & implement practical control procedures; and study the etiology of potato early dying disease with respect to the influence of species of Pratylenchus, fertility, soil moisture and host resistance on the interaction of root-lesion nematodes and Verticillium dahliae; determine the existence of pathotypes in populations of V. dahliae; and develop an improved disease forecasting system.

Approach: Annual field trials of fungicides; isolation of biocontrol agents from root rhizospheres followed by greenhouse and field tests to evaluate efficacy and application techniques; evaluation of temperature and leaf wetness effects on infection of cucumber by O. bryoniae using controlled incubation facilities and development of mathematical disease forecasting model; use of field microplots to evaluate effects of species of Pratylenchus, fertility, soil moisture and host resistance in potato early dying syndrome.

Progress: 87/01 to 87/12. Five rates of Talaromyces flavus and three of Verticillium dahliae were again used in a factorial field microplot study to test Tf as a disease biocontrol agent on potato. Preliminary analysis indicated that no Tf treatment affected disease development or yield. Similar greenhouse studies were conducted to confirm field findings. Isolates of V. dahliae were assigned to vegetative compatibility groups based on pairings of mutants unable to use nitrate. Nine isolates belonged to VCG 3 and ten to VCG 4. Pathogenicity studies indicated that those in VCG 4 are more virulent than those in VCG 3. A survey of 108 radish plantings was conducted to obtain data on effects of environmental and cultural variables on development of Rhizoctonia stem canker. Correlations were found between disease incidence and soil moisture, air temperature, previous crop and radish cultivar. Studies are underway to evaluate relationships of inoculum density and nutrient status of the fungus with disease development. In studies conducted to investigate the etiology of Fusarium crown and root rot of tomato in rockwool culture, we found that the ability of the fungus to colonize this substrate is limited and that control efforts should be aimed at the production of disease-free transplants. Studies were initiated to investigate environmental

effects on development of Didymella bryoniae on cucumber. Spore germination optima were 20-24 C.

Publications: 87/01 to 87/12
ROWE, R.C., DAVIS, J.R., POWELSON, M.L., and ROUSE, D.I. 1987. Potato early dying: Casual agents and management strategies. Plant Dis. 71:482-489.

11.028 0139970
MECHANISMS OF INTERACTION BETWEEN VERTICILLIUM DAHLIAE AND ROOT-LESION NEMATODES IN THE PED SYNDROME

ROWE R C; RIEDEL R M; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000524-SS Project Type: STATE
Agency ID: SAES Period: 01 OCT 89 to 30 SEP 92

Objectives: Effects of root tissue disruption by Pratylechus spp. on activity of Verticillium microsclerotia in the rhizosphere and root surface penetration phenomena; behavior of both pathogens and host tissue changes during interactive colonization, effects of Pratylenchus infection on host hormonal balance and response to Verticillium phytotoxins.

Approach: Microsclerotia of V. dahliae will be placed in root rhizospheres and exposed to root exudates of potato cultivars varying in resistance to Verticillium and previously infected with various Pratylenchus spp. Light microscopy and SEM studies will compare roots of susceptible and resistant cultivars infected with various Pratylenchus spp. and populations of V. dahliae and study effects of Verticillium infection of roots on feeding and penetration behavior of Pratylenchus. Observations will be made on attraction of Pratylenchus to roots, selection of favored feeding sites, and penetration activities as a function of Verticillium infection. Data will be obtained on the effects of simultaneous Verticillium-Pratylenchus infection on the activity of V. dahliae within the plant. Effects of Pratylenchus infection on host sensitivity to V. dahliae phytotoxin and/or changes in host hormonal balance will be studied. Time studies of toxin production in vivo will be conducted using a detached leaf bioassay and direct immunofluorescence.

Progress: 89/10 to 89/12. Preliminary studies with split-root plants having V. dahliae and P. penetrans on separate halves of each root system have shown that the synergism will not occur if both pathogens are physically separated. Detailed studies of interactive mechanisms are planned and will begin this winter.

Publications: 89/10 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

11.029 CRIS0097852
DEVELOPMENT AND VALIDATION OF A MODEL FOR PREDICTING SEVERITY OF EARLY DYING DISEASE IN POTATO

ROWE R C; RIEDEL R M; MADDEN L V; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000389-SS
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 85 to 30 SEP 87

Objectives: Develop a mathematical model to predict potato early dying and potential yield losses as a function of preplant populations of Pratylenchus spp. and V. dahliae. Investigate effects of host resistance to V. dahliae on population levels of Pratylenchus spp. necessary to cause the synergism. Investigage effects of rotational crops on Pratylenchus spp. reproduction and interspecies competition.

Approach: Models will be developed using existing data from field microplots. Empirical, linear regression models and nonlinear regression models will be tested and validated using data collected in 1986 and 1987 from microplots and commercial potato fields. Host resistance studies, using cultivars with varying resistance to V. dahliae will be conducted in field microplots exposed to varying soil populations of V. dahliae and Pratylenchus. Rotational crop effects on interspecific competition will be evaluated in greenhouses using monoxenic cultures of Pratylenchus spp. alone and in various combinations. Nematode population dynamics will be measured in terms of total numbers, reproductive capacity, relative species density and sex ratio.

Progress: 85/01 to 87/09. Using regression and discriminant analyses of a microplot data base collected from 1980-1987 at two Ohio lcations, we have successfully developed a model that predicts yield loss due to potato early dying, relative to controls. The model is based on preplant soil infestation levels of V. dahliae and P. penetrans. An estimated yield loss from this model of 10% at 15 cfu/cm soil for V. dahliae, alone, is in agreement with other estimates in the literature. The model was field tested on two Ohio commercial potato farms in 1987. At each location, disease-free seed pieces were planted in two rows about 400 m long. One hundred, 2 m sections were marked off and soil samples were collected and later for preplant populations of Verticillium dahliae and Pratylenchus species. Data on disease development and yield were collected throughout the season. These data sets are being used to validate the model under field conditions. We have also developed provisional models of yield loss, based on seasonal environmental variables and preplant densities of V. dahliae and P. penetrans. Progress has been made in evaluating important environmental factor, potato phenologiccal events, and disease progression.

Publications: 85/01 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

11.030 CRIS0133925
VALIDATION AND EXTENSION OF MODELS THAT PREDICT YIELD LOSS DUE TO POTATO EARLY DYING

ROWE R C; RIEDEL R M; MADDEN L V; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000458-SS
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 87 to 31 MAY 89

Objectives: Validate in commercial potato fields a preplant disease and cropless prediction model developed from field microplot data; develop further full-season models of disease progress and yield loss including environmental and cultural variables; extend models to include host resistance variables.

Approach: Two commercial fields with varying histories of potato early dying will be selected. Long rows of early generation, disease-free seed potatoes will be planted across these fields. Approximately 100 mini-plots of one row by 10 ft will be marked off and sampled for determination of initial populations of V. dahliae and Pratylenchus species. Data will be taken all season on disease development and yield loss and each data set will be used for model validation studies. Objectives 2 and 3 will be carried out in field microplots exposed to varying soil populations of V. dahliae and P. penetrans.

11.031 0138824
DEVELOPMENT OF MANAGEMENT SYSTEMS FOR POTATO EARLY DYING DISEASE (PED) IN OHIO

ROWE R C; RIEDEL R M; MADDEN L V; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000485-SS Project Type: STATE
Agency ID: SAES Period: 01 JUN 88 to 31 MAY 91

Objectives: Continue field validation of a preliminary yield-loss forecasting model for PED. Continue field microplot studies with controlled populations of V. dahliae and P. penetrans to expand our current data base and incorporate environmental parameters into a full-season model. Evaluate effects of coinfections with root lesion nematodes and V. dahliae on the reaction of potato clones that differ in resistance levels to Verticillium.

Approach: Field validation studies will be composed of 2-row x 5-m plots (100/field) in each of two naturally-infected, commercial potato fields. Disease development and yield data from each plot will be correlated with pre-plant levels of both pathogens and compared with predicted yields. Field microplots will be located at two sites in soil pre-fumigated with methylbromide chloropicrin (3 2). Microplots will be 25 x 30 cm unglazed, clay, field tiles sunk to plow depth. Soil in the tiles will be infested with known populations of root-lesion nematode species from monoxenic alfalfa callus cultures, alone or in combination with various populations of axenically-produced V. dahliae microsclerotia. Each microplot will be planted with a pre-sprouted seedpiece cut from pathogen-free tubers from tissue-cultured potato cultivars varying in resistance to V. dahliae. A completely randomized design with 15 replicate tiles per treatment will be used. Visual symptom data will be collected weekly to construct disease progress curves.

11.032 0138825
DEVELOPMENT OF IMPROVED YIELD-LOSS MODELS FOR POTATO EARLY DYING

ROWE R C; RIEDEL R M; MADDEN L V; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000505-SS Project Type: STATE
Agency ID: SAES Period: 01 JUN 89 to 31 MAY 91

Objectives: To continue improvement and validation in commercial potato fields of models for PED that we have developed under the NC-IPM program. To further improve our preplant models by evaluating the effects on yield-loss prediction of a) potato cultivars varying in maturity and susceptibility to V. dahliae. b) Various geographic isolates of P. penetrans and isolates of V. dahliae representing various vegetative compatibility groups.

Approach: Validation studies will use 2-row x 5 m plots (100/field) in each of two naturally-infected, commercial potato fields. Disease development and yield data will be correlated with pre-plant levels of both pathogens and compared with predicted yields. Microplots (25 x 30cm unglazed, clay, field tiles) will be located at two sites in soil prefumigated with methylbromide chloropicrin (3 2). Soil in the tiles will be infested with known populations of root-lesion nematode species from monoxenic alfalfa callus cultures, alone or in combination with various populations of axenically produced V. dahliae microsclerotia. Each microplot will be planted with a pre-sprouted seed-piece cut from pathogen-free tubers from tissue-cultured potato cultivars varying in resistance to V. dahliae. Visual symptom data will be collected weekly to construct disease progress curves.

11.033 CRIS0142919
DEVELOPMENT OF MANAGEMENT SYSTEMS FOR POTATO EARLY DYING DISEASE IN OHIO

PAPAVIZAS G C; ROWE R C; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: 0500-21010-016-08S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 01 JUN 88 to 31 MAY 90

Objectives: Conduct field validation studies of a yield-loss forecasting model for potato early dying developed in Ohio; perform field microplot studies with controlled populations of Verticillium dahliae and Pratylenchus

penetrans to develop a full season model of disease development in the field; evaluate effects of coinfections with the two pathogens on the reaction of potato clones that differ in resistance to V. dahliae.

Approach: A yield-loss forecasting system will be developed in the field to predict early dying severity. Studies will be done to evaluate the effects of coinfections with root lesion nematodes and Verticillium dahliae on the reaction of potato clones that differ in resistance to Verticillium.

11.034* CRIS0066710
QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESSES

INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: ORE00199 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extraction methodology for nematode detection and assessment. Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determinations of management cost/efficiency functions to allow derivation of economic thresholds.

Approach: Efficiency of nematode extraction from different soil types in Oregon will be compared to between Baermann Funnel, with and without wet sieving, and sucrose centrifugation, with and without wet sieving. The optimum procedure(s) will be compared with elutriation with the help of Dr. Howard Ferris at U.C. Davis. Nematode population dynamics and crop losses to root-knot nematodes will be studied under different irrigation regimes at the Hermiston Experiment Station. Threshold levels for lesion nematodes on mint will be studied in microplot experiments at the Central Oregon Experiment Station. The effect of concommitant infection with Verticillium on these threshold levels will also be examined.

Progress: 87/01 to 87/12. Objective 1: Number of lesion nematodes recovered from Baermann extraction with plastic funnels averaged 15% less than that from glass funnels but this difference was not statistically significant. Objective 2: Soil populations of Meloidogyne chitwoodi second stage juveniles were less in microplots receiving greater than normal amounts of water and greater in microplots receiving less than normal irrigation than in check microplots receiving "normal" levels of water application. Percent tuber infection and number of galls/tuber also decreased with increasing water application. Lesion nematode population growth was not affected by amount of water applied. Objective 3: Individual seed pieces of Russett Burbank Potato were planted (4-16-86) in five gallon microplots infested with 0, 1, 11, 107 or 1069 M. chitwoodi eggs/qt soil. Tubers harvested (9-2-86) from these plants grown under "normal" water application contained 18, 12, 32, 83 or 100% infection with M. chitwoodi respectively. Index of infection on a scale of 0 (no infection) to 6 (100+ gall/tuber) averaged 0.35, 0.25, 0.9, 2.6, and 4.5 respectively. First-year yield of Benton strawberries grown in five-gallon microplots infested with 0, 2,500, 5,000, 10,000 or 20,000 Pratylenchus penetrans averaged 711, 643, 647, 595 or 644 g berries/plant respectively.

Publications: 87/01 to 87/12

SCHROEDER, J.M. 1987. Population dynamics, distribution and control of nematodes in highbush blueberries. M.S. Thesis Oregon State Univ., Corvallis, OR. 97p.

SCHROEDER, J.M., INGHAM, R.E. and GARREN, R. 1987. Population dynamics and control of nematodes in highbush blueberries. Proceedings of the Oregon Horticultural Society 78:153-155.

INGHAM, R.E., SCHROEDER, J.M. and GARREN, R. 1987. Seasonal, vertical and horizontal distribution of plant parasitic nematodes in Oregon highbush blueberry. J. Nematol. 4:531.

11.035* CRIS0098620
IDENTIFICATION, BIOLOGY AND CONTROL OF NEMATODE PESTS IN OREGON AGRICULTURE

INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: ORE00261 Project Type: STATE
Agency ID: SAES Period: 01 JUN 86 to 31 MAY 91

Objectives: Monitor known nematode problems, as well as identify and evaluate potential new problems which may occur as the result of population increases, disease complexes with microbial pathogens or changes in management practices. Research new and existing chemical and management control measures and evaluate their efficacy and cost efficiency for various known nematode pests. Study the biology of plant disease complexes which include nematodes and microbial pathogens.

Approach: A current knowledge of nematode species affecting Oregon agriculture will be maintained by examining samples submitted to the Plant Clinic and by occasional surveys. Chemical control will be examined by treating research plots in growers' fields with new and existing nematicides. Chemicals will be screened for efficacy, phytotoxicity and plant residue. Management practices to be examined include crop rotation sequences and the effects of cover crops on nematode populations in perennial crops. Microplots containing either potatoes or mint will be inoculated with nematodes, Verticillium, both or neither pathogen. Plant growth and yield will be examined for evidence of interactions between the two pathogens.

Progress: 87/01 to 87/12. Vydate 2E at 1 lb ai/A, Mocap 6E at 3 or 6 lb/A and Mocap 10 G at 6 lb/A were evaluated for control of lesion and pin nematodes on peppermint. Treatments were applied on April 15 or 29 to compare efficacy of different treatment dates but nematode

densities in almost all treatments were not significantly different between application dates. Soil populations of lesion nematodes on May 28 were significantly less in the Mocap 6E on April 29 treatment than in the control and all other treatments except Mocap 10G on April 29. At harvest (August 3), densities were lowest in the Mocap 6E on april 29 treatment but were only significantly less than densities in the Vydate treatments. On May 28, numbers of pin nematodes were significantly less in the Vydate and Mocap 10G treatments than in the control. However, on August 3 only the April 15 treatment of Vydate had significantly fewer nematodes that in the control. Nemacur 3 at 6 or 12 lb ai/A was evaluated for control of lesion nematodes on highbush blueberry. The 12 lb ai/A rate significantly reduced lesion nematode populations as compared to the nontreated control but densities were not significantly different from those treated with 6 lb ai/A. Post treatment densities in the 6 and 12 lb ai/A treatments averaged 55% and 5% of those in the nontreated control, respectively.

Publications: 87/01 to 87/12

KAROW, R.S. and INGHAM, R.E. 1986. Cereal cyst nematode (Heterodera avenae Woll.). OSU Crop Science Report, EXT/CRS 66, 5 p.

INGHAM, R.E. 1987. Root-knot nematodes--preventing a potential problem. Proceedings of the 1987 Oregon Potato Conference and Trade Show, pp. 51-55.

11.036 CRIS0130748

INTERACTIONS BETWEEN MELOIDOGYNE CHITWOODI & VERTICILLIUM DAHLIAE IN THE EARLY DYING DISEASE OF POTATOES

POWELSON M L; INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: OREO0287 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 SEP 86 to 30 SEP 88

Objectives: To determine the potential of the nematode, Meloidogyne chitwoodi to cause potato early dying (PED). To evaluate the interaction of M. chitwoodi and the fungus Verticillium dahliae in PED and on tuber yield and quality. To evaluate moisture effects on development of PED, M. chitwoodi populations and tuber yield.

Approach: A microplot system will be established under a drip irrigation system to evaluate these effects. Pathogen populations will be tested individually and in all combinations within each moisture regime. Data on disease severity, tuber yield and quality, and root and shoot dry weight will be collected.

Progress: 87/01 to 87/12. The primary objective of this project was to investigate the potential of Meloidogyne chitwoodi to cause potato early dying (PED) and to evaluate the interactive effects of M. chitwoodi and Verticillium dahliae in PED in cultivar Russet Burbank. A secondary objective was to evaluate moisture effects on disease development. Our research demonstrated that V. dahliae caused PED and that disease severity, as assessed by area under the disease progress curve, was affected by the initial population density of V. dahliae at planting. High amounts of water applied interacted with V. dahliae to cause more severe PED than did lower levels of moisture. M. chitwoodi alone did not cause PED nor did it interact with V. dahliae to cause PED at population densities that individually caused little to no disease. Final tuber yield was also not affected.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

11.037 CRIS0136702

INTERACTIONS BETWEEN MELOIDOGYNE CHITWOODI AND VERTICILLIUM DAHLIAE IN THE EARLY DYING DISEASE OF POTATO

POWELSON M L; INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: OREO0287 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 88 to 31 AUG 89

Objectives: To determine the potential of the nematode, Meloidogyne chitwoodi to cause potato early dying (PED). To evaluate the interaction of M. chitwoodi and the fungus Verticillium dahliae in PED and on tuber yield and quality. To evaluate moisture effects on development of PED, M. chitwoodi populations and tuber yield.

Approach: A microplot system will be established under a drip irrigation system to evaluate these effects. Pathogen populations will be tested individually and in all combinations within each moisture regime. Data on disease severity, tuber yield and quality, and root and shoot dry weight will be collected.

11.038 CRIS0142037

PURIFICATION AND STRUCTURAL DETERMINATION OF THE GOLDEN NEMATODE HATCHING FACTOR II

BRODIE B B; RIOPEL J L; HECHT S; University of Virginia, Charlottesville, **VIRGINIA** 22903.
Proj. No.: 1907-22240-001-04C
Project Type: CONTRACT
Agency ID: ARS Period: 01 MAR 87 to 28 FEB 89

Objectives: Purify and structurally analyze the natural golden nematode hatching factor from potato root diffusate.

Approach: From previously designed procedures using column chromatography the golden nematode hatching factor will be isolated from potato root diffu- sate. Using HPLC the factor will be purified in sufficient quantities for structural determination.

Progress: 87/01 to 87/12. Over the past year an isolation protocol was developed that resulted in the successful isolation of 10 micrograms of the golden nematode hatching

stimulant. This amount proved insufficient for structural determination. However, the following analyses of the active factor were performed. 1) NMR - Four hour pulse yielded no usable data because of small amount of compound. 2) U.V. - spectra revealed no absorbance at wavelengths higher than 220 nm, suggesting that the compound is not aromatic or highly conjugated. 3) Mass Spectroscopy - the compound did not ionize well using electron impact mass spectroscopy, suggesting that part of the compound is very polar. It was concluded that structural determination will require a significantly greater amount of the active factor. Work is in progress to maximize the amount of active factor collected from potato root exudate and to enhance the efficiency of the isolation scheme. To that end, only young plants are being used for root exudate collections and the isolation protocol has been improved.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

11.039 CRIS0143238
ENHANCING DISEASE, PEST, AND STRESS RESISTANCE OF POTATO GERMPLASM

MARTIN M W; THOMAS P E; Agricultural Research Service, Prosser, **WASHINGTON** 99350.
Proj. No.: 5354-22210-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 19 JUL 88 to 18 JUL 93

Objectives: Collect, develop, identify, and maintain disease, pest, and stress resis- tant potato germplasm. Use new crossing and selection technologies to synthesize germplasm with higher levels of resistance and to combine resistance with acceptable horticultural characteristics. Develop super- ior breeding parents for use in cultivar development programs.

Approach: Domestic potato germplasm is collected worldwide and resistances identifiedwhich will be of value to the U.S. potato industry. Progenies of inter- specific crosses from a companion breeding program are screened and evaluated. A mass-intercrossing, recurrent-selection breeding technique is used to enhance and combine resistances as they are identified and move them into genetic bsackgrounds that meet the needs of the potato industry. The effectiveness of early generation selection procedures is evaluated. Valuable germplasm is rendered disease-free by meristem culturing and subsequently maintained and distributed in vitro.

11.040 CRIS0140943
GENETIC AND CYTOGENETIC STUDIES ON GENE TRANSFER IN POTATOES

THOMAS P E; BROWN C; Agricultural Research Service, Prosser, **WASHINGTON** 99350.
Proj. No.: 5354-22000-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 MAR 86 to 01 MAR 91

Objectives: Develop needed technologies to transfer desirable genes from wild and cultivated Solanum species into useable germplasm. Determine desirable genetic characteristics to be transferred, sources of these character- istics, genetic and chromosomal relationships relating to gene transfer. Conduct basic genetic and cytogenetic studies relating to gene transfer.

Approach: Determine which desirable characteristics are adapted to existing or new gene transfer technology, basic inheritance factors related to this technology, barriers related to genetic transfer, and methods of enhancing recombination. Accomplish gene transfer between cross-incompatible genotypes, test resulting new recombinants to determine whether desired gene(s) are expressed.

Progress: 87/01 to 87/12. Resistance to races 1 and 2 of Columbia root-knot nematode (Meloidogyne chitwoodi) was identified in S. bulbocastanum. A technique for assessment of nematode resistance on excised potato roots in sterile culture was developed. The bulbocastanum-type resistance was expressed in greenhouse pot tests and in sterile culture. Resistance to potato leafroll virus was extracted from S. etuberosum, S. acaule, and S. chacoense, and transferred to a more advanced genetic background. Direct utilization of allotetraploid wild species has been achieved by production of fertile triploids that are hybrids of the wild species with cultivated diploid potato. Fertility is achieved through a mutation, contributed by the diploid, for restitution of pollen meiosis; production of 2n pollen with 36 chromosomes. The Endosperm Balance Number of the restituted pollen grains, designated triplandroids, is compatible with normal 1n eggs of cultivated tetraploids. Interspecific triplandroids involving Solanum acaule, S. stoloniferum, S. fendleri, S. polytrichon, S. papita, and S. hjertingii were produced. In cultivated tetraploid styles, a barrier to S. stoloniferum triplandroids was detected. This was overcome by using a mass-flow pollen technique to obtain rare hybrids which were identified by morphology and isozyme markers. In contrast, S. acaule triplandroids were easily crossable to cultivated tetraploid potato. Eradication of Potato Virus S from breeding clones was accomplished in 90% of attempts using a new technique.

Publications: 87/01 to 87/12
BROWN, C.R. 1987. Transfer of traits from primitive cultivars and wild species. Proc. 1987 Wash. State Potato Conf. & Trade Fair, p. 89-92.

11.041* CRIS0065796
DEVELOPMENT OF THE BASIC PARAMETERS FOR NEMATODE PEST MANAGEMENT DECISIONS

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP00240 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extracting methodology for nematode detection and assessment; determination of the relationship between crop losses and nematodes as affected by environmental conditions; and determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: An in-depth sampling study in a center pivot irrigated potato field will be conducted to detect and assess Meloidogyne chitwoodi populations (eggs and juveniles). Factors to be investigated will include: number of subsamples/unit area; soil depth between 0-6'' time of sampling (weekly to monthly); soil type, and cropping sequence. Extraction procedures currently used in WA will be critically examined and compared to other methods to determine the most efficient extraction method and to quantify the level of efficiency. Population densities of M. chitwoodi and M. hapla will be manipulated by inoculation of cropping sequence in microplot and field trials to determine damage functins on several crops. Yield and/or quality of potato, carrots, beans and peas will be related to initial population densities of the nematodes. The influence of environmental conditions and control strategies (crop rotation, resistant varieties and pesticides) on damage functions will be determined.

Progress: 87/01 to 87/12. Reproductive factor (Pf/Pi) of Meloidogyne chitwoodi (MC) race 2 on 44 crop cultivars ranged from 0-130. Nonhost crops (R=0) included asparagus, cowpea, lima bean, peanut, spearmint, strawberry and a hydrid turnip. Reproductive efficiency of MC race 1 and 2 was also compared on selected crop cvs. Both races failed to increase on 9 onion cvs. (R=0=-0.2) and R values on 9 corn cvs. ranged from 0.8-16.9. Alfalfa cvs. Nevada Syn XX and W12SR2W1 exhibited high degree of resistance to M. hapla (MH) and MC races 1 and 2. Population of individual plants of Nevada Syn XX were 100, 90, and 91% resistant to MH, MC1 and MC2, respectively, and W12SR2W1 55, 100 and 65% resistant. In field microplot studies the damage threshold level of MH on Chantenay Red Cored and Orlando Gold carrot was estimated to be 16.7 and 5.6/250 CM soil, respectively. Oamage level for MC races was >2000/250 cm soil. Vertical migration studies in columns buried in the field showed that MC was able to migrate upwards from depths of 60, 120 and 180 cm to infect tomato roots. MC eggs and juveniles placed at 60 cm infected tomato roots within 30 days, while those placed at 120 and 180 cm were detected in tomato roots after 60 days. A total of 1.5 and 3-acre-inches water applied in 8 days was able to move ethoprop down only 10 to 20 cm, respectively, in conceptrations to control MC. Ethoprop at 0.62 mu g/g was able to prevent invastion by MC. Ethoprop EC at 6.7 AI ka/ha protected the treated zone from migrating nematodes for 5 weeks.

Publications: 87/01 to 87/12

PINKERTON, J.N., MOJTEHEDI, H., and SANTO, G.S. 1987. Reproductive efficiency of Pacific Northwest isolates of Meloidogne chitwoodi on alfalfa. Plant Oisease 71:345-348.

PINKERTON, J.N., MOJTAHEOI, H., SANTO, G.S. and O'BANNON, J.N. 1987. Vertical migration of Meloidogyne chitwoodi and M. hapla under controlled temperature. J. Nematol. 19:152-157.

MOJTAHEDI, H., SANTO, G.S. and WILSON, J.H. 1987. Host range of Meloidogyne chitwoodi race 2 (alfalfa race). J. Namatol. 19(4) (Abstr.)

MOJTAHEDI, H., PINKERTON, J.N., SANTO, G.S. and PEAOEN, R.N. 1987. Reproductive efficiency on Meloidogne chitwoodi race 2 and its pathogenicity on alfalfa cultivars. J. Nematol. 10(4) (Abstr.).

11.042* CRIS0091352
PATHOGENICITY, BIOLOGY AND CONTROL OF ROOT-KNOT NEMATODES ON IRRIGATED CROPS IN WASHINGTON

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP00650 Project Type: HATCH
Agency ID: CSRS Period: 01 SEP 83 to 31 AUG 89

Objectives: Oetermine pathogenicity, damage and threshold levels; determine biology (population dynamics, vertical distribution, survival, migratory capabilities, life cycle, number of generations, host-parasite relationships, etc); and determine the efficacy of nematicides in relation to timing and application methods for controlling Meloidogyne chitwoodi and M. hapla.

Approach: Pathogenicity, biology and control studies will be conducted under controlled laboratory, greenhouse, field microplots, and/or natural field conditions. Naturally infested fields or pure root-knot nematode populations reared in the lab or greenhouse will be used to measure effects on plants. Soil used in tests will be free of other pathogens, except under natural field conditions. Experiments will be arranged in randomized block designs with 5 or more replicates. Experimental data to be collected will include measurements of crop yield and/or quality, plant growth, dry weight accumulation, nematode population dynamics in soil and plant tissue, and symptom expression. Environmental conditions including soil types, temperatures, moisture levels, length of growing season will be taken into account as they may affect the pathogenicity, biology and control of root-knot nematodes.

Progress: 87/01 to 87/12. Nematicide trials were conducted to evaluate chemicals for the control of Meloidogyne chitwoodi on potatoes. Treatmennts included fumigants and nonfumigants alone and in combinations; post-plant applications of non-fumigants to protect tubers at the time of nematode invasion; multiple

applications of nonfumigants; and several application methods and rates were used to evaluate fumigants (Telone II, Vapam) and nonfumigants (Mocap, Nemacur, Temik, Vydate). Chemicals registered for use on potatoes as well as experimental compounds were evaluated. Excellent control was obtained with Telone II; fumigants in combination with Mocap; Mocap and Nemacur applied prior to planting and incorporated; and multiple post-plant applications of Mocap. Damage threshold studies show that M. hapla can reduce top growth of peppermint after two years at initial (Pi) inoculum levels of 500, 1,000, and 5,000 juveniles/250 cm soil. On Scotch spearmint growth reduction was observed at Pi of 5,000.

Publications: 87/01 to 87/12

SANTO, G.S., MOJTAEDI, H., PINKERTON, J.N. and WILSON, J.H. 1987. Biological control of root-knot nematodes on potato, 1987. Proc. of 26th Ann. Wash. State Potato Conf., pp. 57-59.

11.043 CRIS0130134

RELATIONSHIP OF ROOT-KNOT AND ROOT-LESION NEMATODES TO EARLY DYING ON POTATO

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP04754 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 SEP 86 to 30 SEP 88

Objectives: To determine the relationship of pratylenchus neglectos, p. penetrans, Meloidogyne chitwoodi and M. hapla to Verticillium dahliae and Erwinia carotovora subsp. carotovora on potato; to determine the effect of environmental factors (soil temperature, soil moisture and soil type) on early dying disease interactions; and to determine the threshold level of each organism needed to produce a synergistic relationship in increasing the incidence and severity of early dying disease.

Approach: Research will be conducted in the greenhouse and field microplots. The greenhouse phase will be used to develop a system to test the relationship of these organisms to the incidence and severity of early dying. When a positive relationship has been established for a nematode species, studies will be conducted under controlled temperature conditions to determine the influence of soil temperature and inoculum densities on early dying disease interaction. Field microplot studies will be used to confirm the relationships obtained in the greenhouse; determine initial population densities of each organism required for a synergistic interaction; and determine the effect of soil type and soil moisture stress on early dying disease development.

Progress: 87/01 to 87/12. Field microplot studies on the interrelationship between Pratylenchus penetrans, Verticillium dahliae, and Erinia carotovoro pv. carotovora alone and in combinations to the Early Die disease on potato show that the disease is more severe in the presence of all three organisms.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

11.044 CRIS0135525

RELATIONSHIP OF ROOT-KNOT AND ROOT-LESION NEMATODES TO EARLY DYING ON POTATO

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP05754 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 88 to 31 AUG 89

Objectives: To determine the relationship of Pratylenchus neglectus, P. penetrans, Meloidogyne chitwoodi and M.hapla to Verticillium dahliae and Erwinia carotovora subsp. carotovora on potato; the effect of environmental factors (soil temperature, soil moisture & soil type) on early dying disease interactions; and the threshold level of each organism needed to produce a synergistic relationship in increasing the incidence and severity of early dying disease.

Approach: Research will be conducted in the greenhouse and field microplots. The greenhouse phase will be used to develop a system to test the relationship of these organisms to the incidence and severity of early dying. When a positive relationship has been established for a nematode species, studies will be conducted under controlled temperature conditions to determine the influence of soil temperature and inoculum densities on early dying disease interaction. Field microplot studies will be used to confirm the relationships obtained in the greenhouse; determine initial population densities of each organism required for a synergistic interaction; and determine the effect of soil type and soil moisture stress on early dying disease development.

11.045 CRIS0094087

OVERWINTER SURVIVAL OF PRATYLENCHUS PENETRANS AND MELOIDOGYNE HAPIA

MACGUIDWIN A E; Plant Pathology; University of Wisconsin, Madison, **WISCONSIN** 53706.
Proj. No.: WIS02917 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 92

Objectives: Determine the effects of abiotic factors and concomitant biota on the overwinter survival of P. penetrans and M. hapla in Wisconsin. Determine the effect of prior exposure to low temperature (cold hardening) on the survival and physiology of P.penetrans and M. hapla exposed to subzero temperatures and freezing events, determine the amount and sources of intraspecific variability in the survival of P. penetrans and M. hapla exposed to subzero temperatures and freezing events, and develop and validate a model to predict the overwinter survival of P. penetrans and M. hapla.

Approach: The post-harvest population dynamics of nematodes, studies in field research plots, will be related to soil temperature, moisture, and the presence of predatory organisms. Nematodes will be exposed to low temperature and freezing in laboratory experiments to further analyze the significance of soil freezing on the decline of nematode populations and to determine some of the mechanisms involved in overwinters survival. Data from field and laboratory studies will be combined to develop a model to predict the population density of nematodes in the spring from population data collected at harvest the preceding fall.

Progress: 87/01 to 87/12. Research plots infested with Pratylenchus spp. and planted to potato (cv Russet Burbank) and corn (Wis 4763) were sampled after harvest and during the winter to estimate the decline in nematode populations. Despite a mild winter, only 24% and 46% of the nematode population survived in corn and potato plots, respectively. Mortality was greatest between October and December. Populations of organisms reported to prey on nematodes increased during the same period. Sampling at 7.5 cm intervals to depths of ca. 38 cm failed to detect any downward movement of nematodes. Very few nematodes were recovered in additional samples collected at depths up to 60 cm. Survival was higher for nematodes inhabiting root tissue than for those in soil. In laboratory studies, P. penetrans was able to survive freezing at -4 C for 24 hrs. Even after pre-exposure to low temperature, nematode life stages differed in their freezing susceptibility.

Publications: 87/01 to 87/12

MACGUIDWIN, A.E. 1987. Abundance and vertical distribution of Pratylenchus scribneri associated with potato in Wisconsin. Amer. Pot. J. 8:448 (Abstr.).

MACGUIDWIN, A.E. Popular Press. Population Dynamics of Nematodes. Badger Common 'Tater'.

11.046 CRIS0097268

DYNAMICS OF THE STRUCTURE AND VERTICAL DISTRIBUTION OF PRATYLENCHUS PENETRANS

MACGUIDWIN A E; Plant Pathology; University of Wisconsin, Madison, **WISCONSIN** 53706.
Proj. No.: WIS02975 Project Type: STATE
Agency ID: SAES Period: 30 SEP 85 to 31 JAN 87

Objectives: Characterize the vertical distribution of P. penetrans associated with potato and corn within and following a growing season. Assess the influence of potato and corn on the age structure of P. penetrans populations in the presence and absence of a host plant. Examine the relation between vertical distribution, overwinter survival and infectivity of P. penetrans.

Approach: Population census data will be collected at a UW experimental farm facility within and between field growing seasons. Controlled experiments will be conducted in laboratory, growth chamber, and green house facilities. This research will advance our understanding of the biology of P. penetrans and facilitate management strategies for this nematode.

Progress: 87/01 to 87/12. The population dynamics of Pratylenchus associated with potato (cv Russet Burbank) and corn (Wis 4763) was studied in irrigated plots in a Plainfield loamy sand soil. Nematode populations associated with corn were higher at depths above 23 cm than at lower depths. Nematode populations associated with potato were greatest at depths of 15-30 cm. The timing of population increase varied with depth in potato plots, but not in corn plots. Nematodes were recovered from soil and root habitats on all dates and by harvest nematodes were distributed equally between the two habitats. Approximately 10% of the nematodes recovered from soil were located on root surfaces. Populations decreased significantly over the winter, with the greatest mortality occurring between harvest and the onset of soil freezing. All stages overwintered, although the predominant life stage was the fourth-stage juvenile.

Publications: 87/01 to 87/12

MACGUIDWIN, A.E. 1986. Overwinter survival of Pratylenchus spp. - who, what, when, and where. J. Nematol. 18:645 (Abstr.).

MACGUIDWIN, A.E. 1987. Abundance and vertical distribution of Pratylenchus scribneri associated with potato in Wisconsin. Am. Pot. J. 8:448 (Abstr.).

MACGUIDWIN, A.E. Population dynamics of Pratylenchus spp. associated with potato and corn. (In preparation).

MACGUIDWIN, A.E. Vertical distribution of Pratylenchus spp. and Longidorus breviannulatus associated with potato and corn. (In preparation).

12.001 CRIS0142958
EVALUATION AND SEED INCREASE OF WATERMELON (CITRULLUS LANATUS) GERMPLASM INTRODUCTIONS

NORTON J D; LOVELL G R; Experiment Station; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: 6607-21000-002-06S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 15 JUN 88 to 31 MAY 93

Objectives: To collect plant descriptor and pathogen resistance data and increase seed of new watermelon (Citrullus lanatus) introductions.

Approach: Sixty foot rows per accession will be planted under field conditions; data will be collected on 9 plant descriptors; data on pathogen resistance will be collected in the greenhouse. Seed will be harvested to provide 5,000 - 9,000 seed of each accession to the Plant Introduction Station. All data collected will be transferred to the GRIN data base.

12.002 0139547
SOIL AMENDMENTS FOR SUPPRESSION OF PLANT PARASITIC NEMATODES

RODRIGUEZ-KABANA R; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36849.
Proj. No.: ALA00800 Project Type: HATCH
Agency ID: CSRS Period: 05 OCT 89 to 30 SEP 94

Objectives: Develop organic amendments to soil that control plant parasitic nematodes and provide nutrients to plants. Characterize the microbial and biochemical processes involved in the suppression of nematodes by the amendments in soil.

Approach: Agricultural "waste material" and by-products of the forest, seafood, and other industries will be examined for their nematicidal properties when used as soil amendments. The mode of action of the amendments on nematodes will be characterized by studying their effects on biochemical and microbial soil processes. The information acquired will beused to establish the requirements in chemical composition of amendments for effective nematode control.

Progress: 89/01 to 89/12. The efficacy of two chitinous (ClandosanR 601 and ClandosanR 719) products derived from blue crab (Callinectes sapidus) wastes for control of Meloidogyne arenaria was studied in a greenhouse experiment. Both materials controlled the nematode on 'Summer Crookneck' squash (Cucurbita pepo) and on a subsequent planting of 'Rutgers' tomato (Lycopersicon esculentum) when preplant incorporated into soil at rates greater than or equal to 10 g/kg of soil. The efficacy of mixtures of urea with Clandosan 601 was explored in a second greenhouse experiment with soil from the same origin. The number of galls/g of fresh squash root (first crop) or tomato (second crop) decreased sharply in response to increasing rates of urea (0-1.0 g/kg of soil) and Clandosan 601 (0-10 g/kg of soil). Treatments with urea alone at rates > 0.5 g/kg of soil were phytotoxic; however, combination treatments of urea + Clandosan 601 were not phytotoxic. Treatments with urea alone or with Clandosan 601 alone resulted in increased fresh shoot weights that were proportional to the rates; the heaviest plants developed in soils treated with the combination urea + Clandosan 601 treatments. Soil chitobiase and urease activities after squash were inversely correlated to the number of galls/g of fresh squash root induced by M. arenaria, but soil phosphatase activity was not correlated. Enzymatic activities of soil were lower after tomato than after squash.

Publications: 89/01 to 89/12

- WEAVER, D.B., RODRIGUEZ-KABANA, R., KING, P.S., and CARDEN, E.L. 1989. Long-term effect of corn rotation on soybean yield and nematode numbers. Proceedings of Southern Soybean Disease Workers. p. 32.
- RODRIGUEZ-KABANA, R., BOUBE, D., and YOUNG, R.W. 1989. Chitinous materials from blue crab for control of root-knot nematode. I. Effect of urea and enzymatic studies. Nematropica 19 53-74.
- RODRIGUEZ-KABANA, R., ROBERTSON, D.G., WELLS, L., KING, P.S., and WEAVER, C.F. 1989. Crops uncommon to Alabama for the management of Meloidogyne arenaria in peanut. Annals of Applied Nematology (Journal of Nematology 21, Supplement).
- RODRIGUEZ-KABANA, R., WEAVER, D.B., ROBERTSON, D.G., KING, P.S., and CARDEN, E.L. 1989. Evaluation of American jointvetch in rotation with selected soybean cultivars for control of root-knot and cyst nematodes.
- RODRIGUEZ-KABANA, R., WEAVER, D.B., ROBERTSON, D.G., YOUNG, R.W., and CARDEN, E.L. 1989. The value of hairy indigo for the management of root-knot and cyst nematodes in soybean. Proceedings Southern Soybean Disease Workers. p. 27.

12.003 CRIS0057873
NATURE AND EXTENT OF VARIATION IN ROOT-KNOT AND CYST NEMATODES

RIGGS R D; ROBBINS R T; SLACK D A; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK00731 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 70 to 30 SEP 87

Objectives: Characterization of the variability in root-knot and cyst nematodes; determination of the abiotic and biotic factors that modify population dynamics of root-knot and cyst nematodes.

Approach: Two populations each of M. incognita will be grown on three hosts at 4 temperatures. At intervals populations will be tested differentials to test for changes in parasitic capabilities. Meloidogyne incognita and Heterodera glycines will be cultured on various hosts with soil additives. Again, the populations will be tested at intervals to

check for changes in parasitic capabilities. Races 3 and 4 of H. glycines will be cultured on good hosts, treated with "contact" nematicides then planted to resistant varieties. Various rates of nematicide will be tested as well as repeated treatments. A series of cultivars of soybeans including resistant resistant and susceptible cultivars will be inoculated with H. glycines or M. incognita or both. After time for one, two or three generations the progeny will be tested on a preselected group of differentials to determine what the parasitic capabilities are and if there have been any changes. Matings between H. glycines and closely related species will be made and the progeny will be checked for changes in parasitic capabilities.

Progress: 87/01 to 87/12. Test of 80 soybean cyst nematode (SCN) populations from several states and three other countries revealed representatives of races 1, 2, 3, 4 and 5 plus six other races which have not been described. Several populations reproduced on Bedford soybean, not a differential. These were from fields where Bedford had been grown 1-3 years. Uniform race tests using differentials from Arkansas, Illinois and North Carolina revealed that the PI 88788 line used in Arkansas was not really PI 88788. This emphasized the importance of uniform differentials from a single source. Isozyme analyses from several cyst species and SCN races indicated that they can be used to separate species but not races. Mitochondrial DNA analyses showed promise for separating SCN races. Ultrastructure studies on Forrest and Bedford soybeans revealed two types of resistance based on the reaction of the tissue to nematode invasion. Single egg mass populations of a Meloidogyne sp. from a soybean field showed considerable variability in host differential response.

Publications: 87/01 to 87/12

SHILLING, K. 1981. Life cycle studies of variants of the soybean cyst nematode, Heterodera glycines. M.S. Thesis. University of Arkansas, Fayetteville.

RIGGS, R.D., HAMBLEN, M.L. and RAKES, L. 1981. Infra-species variation in reaction to hosts in Heterodera glycines populations. J. Nematol. 12:171-179.

RIGGS, R.D., RAKES, L. and HAMBLEN, M.L. 1982. Morphometric and serologic comparisons of a number of populations of cyst nematode. J. Nematol. 14:188-199.

RIGGS, R.D. (Ed.) 1982. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.

RIGGS, R.D. 1982. Cyst nematodes in the Southern region. Pp. 77-95. In R.D. Riggs, ed. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.

SLACK, D.A. and RIGGS, R.D. 1982. The bud and leaf nematodes. Pp. 180-182. In R.D. Riggs, ed. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.

KIM, Y.H., KIM, K.S. and RIGGS, R.D. 1984. Structural changes associated with resistance of soybean to Heterodera glycines. Proc. 1st Internat. Cong. Nematol. p. 43. (Abstr.).

12.004* CRIS0098723

BIOLOGICAL CONTROL OF PLANT-PARASITIC NEMATODES

JAFFEE B A; Nematology; University of California, Davis, **CALIFORNIA** 95616.

Proj. No.: CA-D*-NEM-4666-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Identify soils suppressive to Meloidogyne spp.; determine nature of suppression. Study interaction of Criconemella spp. and its antagonists. Assess potential of zoosporic fungi for biocontrol of Xiphinema spp. Study soil ecology and organism interactions to enhance understanding of potential for nematode biocontrol.

Approach: Assays will be developed to measure levels of suppression of M. incognita in 20 tomato fields. The interaction of C. xenoplax and H. rhossiliensis will be quantitatively described. Parasites will be isolated from X. index and X. californicum; (relative susceptibility of different stages of nematodes to parasitism will be determined). Biology and ecology of antagonists of M. incognita, C. xenoplax, and Xiphinema spp. will be studied to learn how to maximize impact of antagonists on nematodes.

Progress: 87/01 to 87/12. Population densities of Criconemella xenoplax and parasitism by the nematophagous fungus Hirsutella rhossiliensis were quantified at 6 week intervals for 1 year in three peach orchards. Parasitism of the nematode by the fungus was density dependent in 25% of the data sets. Population densities of C. xenoplax were quite stable. The stability appeared to reflect host carrying capacity (root density) rather than density-dependent parasitism by the fungus. Verticillium chlamydosporium and Paecilomyces lilacinus, fungal egg parasites of Meloidogyne incognita, were detected in 9 and 13 of 22 tomato field soils, respectively. The presence of these fungi was not correlated with soil organic matter, pH, texture, or other physical or chemical characteristics. Although these fungi could be recovered from significant proportions of egg masses on tomato roots grown in field soil in the greenhouse, few eggs were parasitized. The bacterial parasite Pasteuria penetrans reproduced in cultures containing M. javanica and Agrobacterium rhizogenes transformed roots.

Publications: 87/01 to 87/12

JAFFEE, B.A., POWELL, C.A. and DERR, M.A. 1986. Incidence of Prunus necrotic ringspot virus in some Pennsylvania peach orchards and nurseries. Plant Disease 70:688-689.

JAFFEE, B.A., HARRISON, M.B., SHAFFER, R.L. and STRANG, M.B. 1987. Seasonal population fluctuations of Xiphinema americanum and X. rivesi in New York and Pennsylvania orchards. Journal of Nematology 19:369-378.

EAYRE, C.G., JAFFEE, B.A. and ZEHR, E.I. 1987. Suppression of Criconemella xenoplax by the nematophagous fungus Hirsutella rhossiliensis. Plant Disease 71:832-834.

JAFFEE, B.A. and SHAFFER, R.L. 1988. Parasitism of Xiphinema americanum and other zoosporic fungi in soil solution, Baermann funnels, or soil. Nematologica. In

press.
JAFFEE, B.A., NYCZEPIR, A.P. and GOLDEN, A.M. 1987. Criconemella spp. in Pennsylvania peach orchards with morphological observations of C. curvata and C ornata. Journal of Nematology 19:420-423.
JAFFEE, B.A., GLENN, D.M., FORER, L.B. and SHAFFER, R.L. 1988. Effect of soil texture on Xiphinema americanum and X. rivesi. Nematologica. Accept for pub.

12.005 CRIS0134506
ISOLATION OF A GENE CONFERRING NEMATODE RESISTANCE TO TOMATO

WILLIAMSON V M; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4920-H Project Type: HATCH
Agency ID: CSRS Period: 12 APR 88 to 30 SEP 92

Objectives: To clone the Mi gene which confers resistance to rootknot nematodes in tomato. To investigate the mechanisms of resistance. To transfer Mi to other plant species.

Approach: We will clone Mi by virtue of its linkage to the gene Aps-1 which encodes acid phosphatase-1. Acid phosphatase-1 will be purified and used to produce antibody and obtain peptide sequence. We will screen a cDNA library for a clone of Aps-1 and use this clone to "walk" to Mi. We will transform susceptible tomato with Mi candidates and assay for resistance to nematodes. An approach to Mi using transposon tagging is also planned. The level, localization and regulation of Mi expression will be determined. Mi will be transferred to other plant species using Agrobacterium based vectors.

12.006 CRIS0098267
QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESS

ROBERTS P A; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4620-RRProject Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: Relate soil initial densities of nematodes and pathogens in field plots to disease, infection, plant growth and yield parameters of field and vegetable crops. Calculate cost/efficacy functions for nematode management inputs, e.g., nematicide and resistant cv. from field experiments for root-knot nematodes in cotton, tomato, and other crops using standard nematode-crop experimental procedures.

Progress: 87/01 to 87/12. Studies continued examination of root infection ratings based on root gall indices as a quantitative predictor of yield loss. Several data sets of Meloidogyne incognita infecting cotton and tomato were collected and analyzed for relationships between amount of root galling (WNR) at end of Crop Year 1 with soil initial population densities in Crop Year 2 (Pi2) (R values ranged from 0.53 to 0.98), with relative yield in Crop Year 2 (Y2)(R from 0.53 to 0.98), and for Pi2 with Y2 (R from 0.54 to 0.97). These relationships were described by linear or more often quadratic functions. Impact on the relationships of resistant cultivar for tomato and cotton and of Fusarium wilt for cotton were found to be significant. Field validation tests for commercial implementation of root gall assays in cotton were started in a 60 acre block.

Publications: 87/01 to 87/12
BENEDICT, J.H., EL-ZIK, K.M., GUTIERREZ, A.P., OLIVER, L.R., ROBERTS, P.A. and WILSON, L.T. 1988. Economic injury levels for cotton pests. Chapter 6. Integrated Pest Management Systems and Cotton Production.

12.007 CRIS0086370
MANAGEMENT AND RELATED BIOLOGY OF NEMATODE PARASITES OF FIELD AND VEGETABLE CROPS

ROBERTS P A; THOMASON I J; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4187 Project Type: STATE
Agency ID: SAES Period: 01 NOV 87 to 30 SEP 92

Objectives: Determine distribution and abundance of nematodes. Define host-parasite relationship and pathogenicity of new or poorly understood nematodes. Study population dynamics, soil distribution, survival, damage threshold levels of nematodes, singly and in mixed populations, and influence of biological and physical environment on nematodes and crop injury. Develop nematode management programs utilizing biological, chemical, cultural, and resistance strategies.

Approach: Survey, isolate, identify, and culture nematodes associated with crop damage. Inoculate plants and measure host response as influenced by environment, under greenhouse and field conditions. Evaluate and refine management strategies on nematode infested field sites.

Progress: 87/01 to 87/12. Rotation studies continued for a second year to examine impact of Meloidogyne spp. resistant tomatoes on multiseason nematode population dynamics. Susceptible crops of cotton, Acala SJ2, and freezer beans, Massy M16 and Dixie Buttercup, grown on 1,3-D fumigated and nonfumigated plots following a previous planting to resistant tomato on infested fields showed no response to fumigation. These results clearly demonstrate utility of resistant tomato in protecting succeeding crops by reducing nematode populations. Metham-sodium drip-applications to

vegetable planting beds were monitored by horizontal and vertical grid-core samplings to determine distribution of liberated MIT in soil profiles. Significant accumulation of MIT occurred in upper 30-45 cm depth, and increased application water improved penetration. An in-field MIT monitoring probe is being developed for rapid assay of MIT levels. Expression of Meloidogyne incognita and M. javanica resistance was demonstrated in a synthetic hexaploid wheat, derived from Aegilops squarrosa. Inheritance study tests with F(2) progeny suggest a simple dominant gene for resistance in Ae. squarrosa. Combined seed (phenamiphos), soil (ethoprop), and foliage (oxamyl) treatments (designed to reduce nematicide load in soil) for control of Heterodera schachtii on sugar beet were tested in the summer of 1987 in Riverside. Combined treatments were no better than soil treatment alone.

Publications: 87/01 to 87/12

LESTER, R.N. and ROBERTS, P.A. 1986. Serotaxonomy of Solanum, Capsicum, Ounalia and other selected Solanaceae. Ann. Missouri Bot. Gard. 73:128-133.

RAOEWALO, J.O., MCKENRY, M.V., ROBERTS, P.A. and WESTEROAHL, B.B. 1987. The importance of soil fumigation for nematode control. Calif. Agric. 41(11 and 12):16-17.

ROBERTS, P.A. and THOMASON, I.J. 1988. Screening of a granular chelate of metham zinc for nematicidal activity using citrus and root-know nematodes. Ann. of Appl. Nematol. 2 (in press).

ROBERTS, P.A., MAGYAROSY, A.C., MATTHEWS, W.C. and MAY, O.M. 1988. Effects of metham sodium applied by drip irrigation on soil populations of root-knot nematodes, Pythium ultimum and Fusarium sp., and infection of carrot and tomato roots.

KALOSHIAN, I., ROBERTS, P.A. and THOMASON, I.J. 1987. Expression of resistance to Meloidogyne javanica in a synthetic allohexaploid developed from durum wheat and Aegilops squarrosa. J. Nematol. 19:534.

12.008 CRIS0097963

GENETIC IMPROVEMENT OF BEANS (PHASEOLUS VULGARIS L.) FOR YIELD, PEST RESISTANCE AND FOOD VALUE

THOMASON I J; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4621-RRProject Type: HATCH
Agency IO: CSRS Period: 04 MAR 86 to 30 SEP 89

Objectives: Determine and exploit genetic mechanisms regulating horizontal resistance.

Approach: Meloidogyne spp., Pratylenchus penetrans & P. scribneri are injurious to beans. These can also aggravate root-rots caused by fungi. Resistance to M. incognita is known. Resistance to other Meloidogyne spp. and other genera is needed. Efficient test methods for resistance have been established. These techniques will be applied to a range of cultivars and lines of Phaseolus species.

Progress: 87/01 to 87/12. Two factors determine the suitability of a nematode "resistant" bean. One is hosting ability as measured by nematode reproduction, the other is tolerance to damage. With Meloidogyne spp. the galling on roots may be involved in tolerance but there is not a direct relationship between galling and egg mass production. However, roots must be exposed to observe galling and/or egg masses. With beans this is a destructive process because plants 4 to 6 weeks old to not transplant well and cuttings do not root readily. A nondestructive technique was developed for screening beans for resistance to these nematodes based on egg mass counts. Plants were grown in growth pouches. One week after germination plants were inoculated with 2000 juveniles. Three weeks later plants were irrigated daily for one week with 50ppm of the dye erioglaucine. This dye stains egg masses but not females. Stained egg masses were counted 4 weeks after inoculation and evaluated plants planted into soil and grown to maturity. Survival was good. Egg mass counts were most highly correlated to nematode reproduction (r=0.85) than either gall index or egg index. Good resistance to Meloidogyne javanica (as measured by lack of nematode reproduction) has been found in common beans from CIAT in Columbia. Genetics of resistance has been frustrated by incapatibility factors between large and small seeded lines but is being solved.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

12.009 CRIS0140375

CHEMICAL AND MOLECULAR BASIS OF HOST-PLANT RESISTANCE TO PESTS

JURO L; WAISS A C JR; DAVIS C; Natural Products Chemistry Research Unit; Western Regional Res Center, Albany, **CALIFORNIA** 94710.
Proj. No.: 5325-24000-004-000
Project Type: INHOUSE
Agency IO: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: To reduce crop losses from insect, nematode and disease damage via utilization of natural pest resistance systems.

Approach: The chemical basis of pest-plant interactions in the following areas will be studied: (1) Chemical mechanism of tomato and other crop plants which cause resistance to root-knot nematodes and the enhancement of those chemical factors through phytoalexin formation or by the use of plant growth bioregulators. (2) Chemical constituents in corn silk responsible for corn resistance to the corn earworm and development of assay proceduresdesigned to aid plant breeders. (3) The nature and (symbiotic?) origin of hydrolytic enzymes in the saliva of sucking insects which mediate insect probing by depolymerizing plant polysaccharides and the structural features which hinder depolymerization of such polysaccharides.

Progress: 86/01 to 86/12. Several plant species in the genera of Physalis & Petunia exhibit extremely high level of resistance in tomato fruitworm (H. zea). A series of previously unknown steroidal compounds with larval growth inhibiting activity have been isolated from petunia. Others are being isolated from P. ixocarpa (tomatillo) & P. peruviana (cape gooseberry). The possibility of introducing insect & pathogen resistance in tomato & potato through intergeneric protoplast fusion & genetic transfer techniques are being considered. Analysis of tomato roots for tomatine was carried out on a series of tomato plants with varying degrees of resistance to root-knot nematode (M. incognita). Lack of correlation of tomatine content with resistance showed that tomatine is not a key nematode resistance factor although it is of significance in fungal & insect resistance. With the expectation that pectinases in aphid saliva can trigger phytoalexin formation in plants, the tissue culture of aphid susceptible & resistant lines of alfalfa have been established. Treatment of these tissue cultures with elicitors have not given the same phytoalexins as described for alfalfa in the literature. Work on the nature of the phytoalexins produced is in progress. The alkaloid, castanospermine, was shown to inhibit enzymes which degrade cell wall polysaccharides. The enzymes are in insects which harbor intercellular prokaryotic bacteria. Work was initiated on genetic engineering studies on insect endosymbiotes.

Publications: 86/01 to 86/12

LEE, M.S., GARAS, N.A. & WAISS, A.C., JR. 1986. HPLC Determination of Sesquiterpenoid Stress Metabolites in Verticillium dahiae infected cotton stele. J. Agric. Food Chem. 490-493.

GARAS, N.A. & WAISS, A.C., JR. 1986. Differential accumulation & distribution of antifungal sesquiterpenoids in cotton stems inoculated with Verticillium dahlin. Phytoph. 76:1011-1017.

GARAS, N.A., WILHEM, S. & SAGEN, J.E. 1986. Relationship of cultivar resistance to distribution of Verticillium dahlia in inoculated cotton plants and to growth of single conidia on excised stem segments. Phytoph. 76: 1005-1010.

DREYER, D.L. 1986. Some structural and stereochemical aspects of coumarin biosynthesis. Recent Adv. in Phytochem. 317-337.

CAMPBELL, B.C. 1986. Host-plant oligosaccharides in the honeydew of Schizahis graminum (Rondani) (Insects, Aphididae). Experientia 42: 151-152.

CAMPBELL, B.C., JONES, K.C. and DREYER, D.L. 1986. Discriminative behavioral responses by aphids to various plant matrix polysaccharides. Entomol. Exp. & Appl. 41: 17-24.

12.010 CRIS0085692
DEVELOPMENT OF ENTOMOPATHOGENS FOR USE IN PEST MANAGEMENT SYSTEMS

CAPINERA J L; Entomology; Colorado State University, Fort Collins, **COLORADO** 80523.

Proj. No.: COL00227 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To evaluate and optimize efficacy of entomopathogenic formulations.

Approach: Efficacy determinations for utilization of entomophagous nematodes in Colorado crop and urban pest situations will be made. Included will be investigations on selection and development of appropriate application timing and evaluation of cultural practices on efficacy. Methods of increasing infectivity (potency) and field stability also will be explored.

Progress: 87/01 to 87/12. Trials were conducted with N. carpocapsae (Mexican) for control of immature flies infesting bedding plants (fungus gnats, shore flies and moth flies). Nematode treatments failed to reduce the number of adult flies emerging from potted media. Field Trials: The entomogenous nematodes, N. carpocapsae (50k/ft and H. heliothidis (50k/ft), were applied to turf infested with the white grub Cyclocephala sp. The application resulted in a significant decrease from the of grubs found in the control plots. (Pueblo). Field Trials: Corn earworm. The entomogenous nematode, N. carpocapsae "Breton" was applied to sweetcorn to determine levels of efficacy in controlling corn earworm Heliothis zea. Corn earworm mortality was found to be significantly higher in those plots in which the nematodes were applied to the corn ears.

Publications: 87/01 to 87/12

CAPINERA, J.L. 1987. Observations on natural and experimental parasitism of insects by Mermis nigresceus Dujardin (Nematoda: Mermithidae). J. Kansas Entomol. Soc. 60: 159-162.

12.011* CRIS0134378
ASSESSING YIELD LOSS DUE TO CROP DAMAGE IN TERMS OF INTERCEPTED LIGHT

FERRANDINO F J; Plant Pathology & Ecology; Connecticut Agri Expt Station, New Haven, **CONNECTICUT** 06504.

Proj. No.: CONH00692 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 29 FEB 92

Objectives: Determine the relation between yield and crop damage caused by disease and insects by answering the questions: How is the total light energy intercepted by healthy leaves related to final yield for plants damaged by: diseases which cause rapid defoliation, diseases characterized by local lesions, wilt diseases, and insect herbivory? How is the net assimilation, dark respiration, and partitioning of photosynthate affected by disease and herbivory.

Approach: The relationships among the total plant dry weight, the dry weight of marketable yield and the total light intercepted by the plant over the growing season will be examined for several crop-pest systems including potato, defoliated by late blight and Colorado potato beetles, tomato affected by early blight, snap beans affected by bean rust, corn affected by corn rust, and tobacco attacked by nematodes. Yields from manually defoliated sections of control plots will be compared to the yields from areas sustaining damage by pests. Intercepted light will be measured using tube solarimeters. The severity of damage including fallen vegetation, will be measured. Final dry weight of the various organs of the plants will be determined and the quality of the final marketable product will be estimated. The rate of total dry weight increase per unit light energy intercepted will be estimated graphically from a plot of total plant dry weight versus total intercepted light.

12.012 CRIS0136340
IMPROVED FIELD PRODUCTION OF HERBS AND SPICES

FRENCH E C; COLVIN D L; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-AGR-02761
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 89

Objectives: To determine appropriate germplasm for 9 herb/spice species. To determine susceptibility of 9 herb/spice species to Meloidogyne spp. of nematode. Determine appropriate weed control agents for herb/spice production. Determine seed germination parameters and planting technique. Determine plant response (dry, fresh and essential oil yield) to applied levels of fertilizer.

Approach: Establish germplasm introduction nursery, screen for nematode susceptibility, screen weed control agents, carry out seed physiology research, carry out field planting technique studies, carry out fertility trials.

12.013 CRIS0132201
BIOLOGICAL CONTROL OF PEST MOLE CRICKETS

FRANK J H; WALKER T J; BOUCIAS D G; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02636 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To improve methods for laboratory culture of the mole crickets Scapteriscus vicinus and S. acletus. To complete evaluation of the effectiveness of the Uruguayan strain of the parasitic nematode Neoaplectana carpocapsae as a biological control agent of Scapteriscus mole crickets, and to develop economically feasible field application methods. To complete evaluation of the effectiveness of the parasitic wasp Larra bicolor as a biological control agent of Scapteriscus mole crickets, and to investigate other Larra species. To perform laboratory and field evaluations of fungal, viral, and microsporidan pathogens of mole crickets.

Approach: To devise a method for successful laboratory colonization and evaluate production of the tachinid fly Euphasiopteryx depleta. To study the life cycle of as many species of the bombardier beetle genus Pheropsophus as possible in quarantine, and to determine which, as larvae, are specialized predators of mole cricket eggs.

Progress: 87/10 to 88/09. The parasitic nematode (Neoaplectana sp., Steinernematidae) from Uruguay which was first released in Florida in 1985 continues to suppress mole cricket populations at the sites of release. It has turned up at a control site >1 km from a release site, presumably spread there by infected mole crickets. Results of field studies at Ft. Lauderdale, Florida, where the parasitic wasp Larra bicolor (Hymenoptera: Sphecidae) has been established since 1981, show that the wasp parasitizes Scapteriscus abbreviatus in the field, with no evidence of parasitism of S. acletus or S. vicinus. An iridovirus detected in Scapteriscus acletus in southern Brazil where it was causing an epizootic has characteristics which do not match those of any described iridovirus. No iridovirus has been reported previously from an orthopteran host, and this one is a potential biocontrol agent for mole crickets if it proves to be safe to non-target organisms. Adult females of the parasitic fly Euphasiopteryx depleta (Diptera: Tachinidae) were trapped in southern Brazil routinely from mid-October 1987. Some of the flies were carried to a quarantine facility in Florida in November 1987 where larvae dissected from them were inoculated onto mole crickets. Many of the larvae developed successfully and some of the resultant adults mated successfully in the laboratory for the first time. Over 200 puparia of a following generation were released in Alachua Co., Florida, in late April 1988, and over 200 at the beginning of June.

Publications: 87/10 to 88/09

BOUCIAS, D.G., MARUNIAK, J.E. and PENDLAND, J.C. 1987. Characterization of an iridovirus isolated from the southern mole cricket, Scapteriscus vicinus. J. Invert. Pathol. 50: 238-245.

CASTNER, J.K. 1988. Biology of the mole cricket parasitoid Larra bicolor (Hymenoptera: Sphecidae) (p. 423-432 in) GUPTA, V.J. (ed.) Advances in parasitic Hymenoptera Research, 1988. Brill, Leiden (in press).

FOWLER, H.G. 1987. Field behavior of Euphasiopteryx depleta (Diptera: Tachinidae): phonotactically orienting parasitoids of mole crickets (Orthoptera: Gryllotalpidae: Scapteriscus). J. New York Ent. Soc. 95: 474-480.

FOWLER, H.G. 1987. Field confirmation of the phonotaxis of Euphasiopteryx depleta (Diptera: Tachinidae) to calling males of Scapteriscus vicinus (Orthoptera:

Gryllotalpidae). Florida Ent. 70: 409-410.
FRANK, J.H. and SMART, G.C. 1988. The parasitic nematode Neoaplectana n. sp. as a biological control agent of mole crickets (p. 25-29 in) Report of turfgrass research supported by the FTGA 1987-1988. Univ. Florida, IFAS, i + 47 p.

12.014 CRIS0132936
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING VEGETABLE CROPS

MCSORLEY R T; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02494 Project Type: STATE
Agency ID: SAES Period: 10 JUL 85 to 30 SEP 90

Objectives: Investigation of the biology and host-parasitic relationships of phyto-parasitic nematodes associated with vegetable crops grown in Florida. Evaluation and development of management strategies designed to reduce economic losses due to nematodes attacking vegetable crops.

Approach: Biology and host-parasite relationships to be investigated through: Nematological surveys to determine nematode-host associations, detailed studies of nematode life cycles, pathogenicity tests and development of relationships between yield and nematode density, ecological studies relating nematode population fluctuations to environmental factors. Management strategies will be investigated with several goals in mind: development and understanding of biological and cultural control methods, evaluation and assessment of chemicals, biological, and cultural strategies, integration of nematode management practices into overall crop management systems.

Progress: 87/09 to 88/06. Reviews on nematode extraction and sampling, and also on modeling nematode population dynamics, have been completed and published. Guidelines have been proposed for designing appropriate plot sizes for nematode field studies, with examples provided for 6 vegetable crops. Guidelines have also been proposed for standardizing nematicide application rates, based on the calibration rate used per unit of treated area. Estimates of nematode losses on vegetable crops have been summarized for a recent Society of Nematologists publication, and range from zero on asparagus to 12% on cucumber and potato to 15% on carrot. Research on effects of summer cropping systems on potato production has been completed and published. Summer fallow was the best alternative for reducing nematode and wireworm populations and improving yield. Summer cover cropping with sorghum for various lengths of time increased nematode populations in some cases, but did not affect the gross weight of potatoes produced. However, the percent of tubers showing wireworm damage increased with the length of time sorghum was cultivated during the summer, following the relation $Y = 0.0155 + 0.166X - 0.00070X$, where Y = percent of potatoes with damage, and X = number of days sorghum was grown. The ring nematode Criconemella onoensis increased to high numbers on sorghum, but in controlled greenhouse and field experiments, no damage could be attributed even to extremely high (>1000/100cm soil) populations of this nematode.

Publications: 87/09 to 88/06
MCSORLEY, R. 1987. Plot size and design for acquisition of field data in nematology. Vistas on Nematology. Society of Nematologists, Hyattsville. J.A. Veech and D.W. Dickson (eds.). pp. 52-58.
MCSORLEY, R. 1987. Extraction of nematodes and sampling methods. Principles and Practice of Nematode Control in Crops. Academic Press, Sydney. R.H. Brown and B. R. Kerry (eds.) pp. 13-47.
DUNCAN, L.W. and MCSORLEY, R. 1987. Modeling nematode populations. Vistas on Nematology. Society of Nematologists, Hyattsville. J.A. Veech and D.W. Dickson (eds.). pp. 377-389.
DICKSON, D.W. and MCSORLEY, R. 1987. Standardization of nematicide application rates. Ann. Appl. Nematol. 1:1-5.
MCSORLEY, R., PARRADO, J.L., TYSON, R.V., WADDIL, V.H., LAMBERTS, M.L. and REYNOLDS, J.S. 1987. Effect of sorghum cropping practices on winter potato production. Nematropica 17:45-60.
MCSORLEY, R., PARRADO, J.L., TYSON, R.V. and REYNOLDS, J.S. 1987. Effect of Criconemella onoensis on potato. J. Nematol. 19:228-232.

12.015 CRIS0092658
BIOLOGICAL CONTROL OF PLANT PARASITIC NEMATODES AND OF INSECTS BY ENTOMOGENOUS NEMATODES

SMART G C JR; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02433 Project Type: STATE
Agency ID: SAES Period: 06 MAR 84 to 31 DEC 88

Objectives: To evaluate organisms such as fungi, bacteria and antagonistic plants as biological control agents of plant parasitic nematodes. To evaluate entomogenous nematodes as biological control agents of noxious insects.

Approach: The fungus, Paecilomyces lilacinus, will be used in experiments to control the root-knot nematode, Meloidogyne incognita. The fungus will be used alone and in conjunction with the bacterial spore parasite, Bacillus penetrans. B. penetrans also will be used alone. Other fungi and other nematodes may be used in future experiments. Antagonistic plants to be used are the digitgrasses, Pangola digitgrass initially against M. incognita and Transvala digitgrass against the sting nematode, Belonolaimus longicaudatus. Initial research will be with Neoaplectana carpocapsae against the mole crickets Scapteriscus acletus and S. vicinus.

Progress: 87/10 to 88/09. For more than three years after release of a Neoaplectana sp. (formerly called N. carpocapsae = Steinernema) from Uruguay in three small (50 m2) plots, the nematode is still causing about a 10% infection

of mole crickets. The nematode has spread from the release sites (at least 5 miles after three years), and mole cricket populations, as measured by capture of nymphs in pitfall traps, has gone from an average of 93 lymphs before treatment to 16 one year later to 6 after two years and to 4 after three years. Damage to the grass has decreased. When placed on the soil surface or just under it, the infective-stage juveniles moved downward 10 cm, infected and killed mole crickets in dishes below. They moved downward as readily outdoors in field soil as in containers of soil in the laboratory, and in fact, killed mole crickets more efficiently in the field with a concentration of nematodes 5 times less than in the laboratory. When placed in the center of a soil column, the nematodes moved both upward and downward 8 cm with a greater number moving down than up. Infective-stage juveniles were buried in the soil in tightly sealed containers or in containers covered with 10 um Nitex cloth. In both types of containers the nematodes survived and were able to kill mole crickets after the 8 or 10 weeks of the tests. Even though the numbers that survive are reduced rapidly during the first week, numbers decline much more gradually during subsequent weeks.

Publications: 87/10 to 88/09

OLEXA, M.T. and SMART, G.C., JR. 1987. Pesticides and public employee liability. Journal of Nematology 19:549 (Abstr.).

GERBER, K., SMART, G.C. and ESSER, R.P. 1987. A comprehensive catalog of plant parasitic nematodes associated with aquatic and wetland plants. Bulletin 871 (Technical) 170 pp. Agric. Expt. Sta., IFAS, Univ. Fla., Gainesville.

NGUYEN, K.B. and SMART, G.C., JR. 1988. Mode of entry of neoaplectanid nematodes into mole crickets. Soil and Crop Science Society of Florida, Proceedings 47:250 (Abstr.).

12.016 CRIS0135743

BIOLOGICAL CONTROL OF THE SWEETPOTATO WEEVIL: PATHOGENICITY AND EFFICACY OF ENTOMOPATHOGENIC NEMATODES

SMART G C JR; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02756
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 89

Objectives: Isolate and identify endemic entomopathogenic nematodes species in soils of southern Florida and the Caribbean basin; determine virulence of several known nematode species and strains to sweetpotato weevil; determine optimal environmental conditions required for maximum infection of the weevil; determine efficacy of the most virulent strains of nematodes at managing sweetpotato weevil in southern Florida and Puerto Rico; determine the persistence of the most virulent strains in the field.

Approach: Isolate nematodes using Galleria melonella (L) larval traps; conduct laboratory experiments (petri dish bioassays, apply nematodes to soil above buried sweet potato roots infested with weevil larvae and pupae) and controlled-environment experiments (temperature, humidity, soil moisture) to determine virulence and optimal conditions for infection; conduct field experiments and compare results to those obtained with insecticides. Survey soil for persistence.

12.017 CRIS0095237

HOST-INDEPENDENT ENDOSPORE PRODUCTION FROM A BACTERIAL PATHOGEN OF ROOT-KNOT NEMATODES

PREVIC E P; Microbiology & Cell Science; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-MCS-02488 Project Type: STATE
Agency ID: SAES Period: 21 MAR 85 to 30 SEP 90

Objectives: Develop procedures for growing BSPN (bacterial spore parasite of nematodes), independent of nematode hosts, with goal of large scale production of BSPN spores. Study molecular interactions of BSPN spore surface components with receptors on cuticle surface of nematode hosts.

Approach: Grow BSPN in Meloidogyne species of root-knot nematodes on tomato plants by standard methods. Harvest female nematodes to collect BSPN spores, and at intermediate stages to isolate vegetative form of BSPN. Subject BSPN spores (and any recovered vegetative cells) to diverse conditions which are known to favor activation and outgrowth of spores of endospore-forming procaryotic microorganisms. Subject BSPN spores to activation with fractions of nematode cuticles and root exudates. Monitor activation and outgrowth of BSPN by optical density, electron microscopy, photometric immersion refractrometry and chemical changes in cortex peptidoglycan and other components. Remove BSPN spore coats and exosporia by di-sulfide bond-breaking reagents and/or enzymes. Test capacity of altered spores to bind to nematode hosts.

Progress: 87/10 to 88/09. Pasteuria penetrans and Pasteuria thornei were grown in their respective host nematodes, Meliodogyne incognita and Pratylenchus brachyurus, both on excised root cultures (tomato and corn), and in explanted tissues on tissue culture media. Endospores were produced in each situation. Studies are continuing on these and other Pasteuria in attempts to transfer their vegetative growth phase from their natural host nematodes to "non-host" nematode tissues. In part, this approach is designed to show if the natural host is required only for the germination of spores of its specific Pasteuria parasite, or if the specificity resides also in the composition of the host tissues and/or pseudocoelomic fluid.

Publications: 87/10 to 88/09
NO PUBLICATIONS REPORTED THIS PERIOD.

12.018 CRIS0096070
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING VEGETABLE CROPS

OVERMAN A J; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 34203.
Proj. No.: FLA-BRA-02494 Project Type: STATE
Agency ID: SAES Period: 10 JUL 85 to 30 SEP 90

Objectives: Investigation of the biology and host-parasitic relationships of phytoparasitic nematodes associated with vegetable crops grown in Florida. Evaluation and development of management strategies designed to reduce economic losses due to nematodes attacking vegetable crops.

Approach: Evaluate cover crops in rotation with tomatoes in an effort to suppress nematode species attacking tomato. Study the relationship of mulching and irrigation methods to nematode survival and development. Evaluate efficacy of fumigants and "contact" nematicides applied by various methods on vegetable fields. Develop systems for population management which would be compatible with the full-bed mulch concept physically, environmentally and economically. Establish relationship of nematodes to solarization, crop rotation, and multicropping in-row culture.

Progress: 87/10 to 88/09. A continuing project using a liquid fertilizer applicator (Liquid Ed Injector Wheel Model B) involved injection of metam sodium at the rate of 3.8, 7.6, or 11.4 l/roll of plastic mulch used to seal beds of row crops. The low rate was applied in 1 run down the bed center, the medium rate is 2 runs 14 cm apart, the high rate a combination of 1 run down center and 2 runs 14 cm apart. Treatments for a double crop of tomato following tomato increased the second crop yield 27, 20, 24%, respectively. The first crop stubble was killed only by applications down the center of the bed. Solarization: Three plastic mulch formulations were evaluated in solarized plots: 4 mil polyethylene (Rex), 3 & 4 mil Sunsaver registered trademake polyethylene. Solarized plots were compared for 8 weeks with Sesbania macrocarpa prior to bedding and fumigating rows in each off-season treatment with Telone II (168 l/ha), methyl bromide 98%/chloropicrin 2% (112 or 336 kg/ha) or MBC 67/33 (392 kg/ha). Soil temperatures at 30 cm deep were approximately 10 F higher under 4 mil Sunsaver than under Rex, and 5 higher than under 3 mil Sunsaver. Rex plastic temperatures 30 cm deep were about 5 higher than under Sesbania. Maximum temperatures attained (transiently) were at 15 cm under 3 mil Sunsaver (110 F). The 3 mil Sunsaver + MBC 98/2 at 112 kg/ha produced the highest yield (24t/ha) in the subsequent tomato crop followed by 4 mil Sunsaver + MBC 33/67 (20t/ha).

Publications: 87/10 to 88/09
OVERMAN, A.J. and JONES, J.P. 1988. Solarization and fumigation for tomato in sandy soil. Nematropica 18(1):16.
OVERMAN, A.J. and NOLING, J.W. 1988. Movement, dissipation, and efficacy of Mocap for tomato in a shallow, poorly drained soil. Proc. Soil and Crop Sci. Soc. Fla. 47: (In press).
NOLING, J.W. and OVERMAN, A.J. 1988. Prescriptive approaches to soil pest control with methyl bromide and chloropicrin. Univ. of Fla. Coop. Ext. Serv. Nematology Plant Protection Pointer.
MAGIE, R.O., OVERMAN, A.J., GILREATH, J.P., PRICE, J.F., WILFRET, G.J. and WOLTZ, S.S. 1988. Gladiolus Corm Production. GCREC Res. Rept. BRA1988-7. 20 pp.
NOLING, J.W. and OVERMAN, A.J. 1988. Movement, dissipation, and efficacy of ethoprop in citrus in a deep, well drained sandy soil. J. of Nematology 20(4):653. (Abstr.).
OVERMAN, A.J. and NOLING, J.W. 1988. Movement, dissipation, and efficacy of ethoprop for tomato in a shallow, poorly drained soil. J. of Nematology 20(4):655. (Abstr.).
HARBAUGH, B.K., WILFRET, G.J. and OVERMAN, A.J. 1988. Tissue cultured stock history and hot water treatment affect caladium tuber production on sandy soils. Proc. Fla. State Hort. Soc. 101: (In press).

12.019* CRIS0095463
TRICKLE IRRIGATION IN HUMID REGIONS

OVERMAN A J; STANLEY C D; CSIZINSZKY A A; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 34203.
Proj. No.: FLA-BRA-02487 Project Type: HATCH
Agency ID: CSRS Period: 12 DEC 84 to 30 SEP 89

Objectives: To determine crop water requirements and optimum crop and water management methods for trickle irrigation in humid regions. To develop basic guidelines and procedures for applying nutrients and pesticides and determine water and chemical distribution patterns in relation to root systems. To develop specific design criteria and procedures for trickle systems in humid regions: a) to evaluate design application rates; b) to evaluate number and location of emitters; c) to characterize the hydraulic principles for proper and efficient system operation; and d) to determine optimum system configuation with regard to cultural and management practices.

Approach: Row crops of vegetables and ornamentals will be grown with drip irrigation systems varying frequency and volume, introducing pesticides and nutrients, evaluating placement of water and potential minimal irrigation levels in both spring and fall growing seasons on sandy soil.

Progress: 87/10 to 88/09. Nemagation: Methyl bromide 98%/chloropicrin 2% (.25 or .5 kg 30 m- row) injected as a dry gas into a biwall tube buried 7 cm deep mid-bed increased a primary mulched tomato (Lycopersicon esculentum Mill cv. Sunny) crop on sandy soil 33 or 58%, respectively, & in a double crop mode where plastic was no longer a complete film, the low

rate increased yield 31%. Five genera of nematodes inhabited the soil: 98 days after nemagation populations of Belonolaimus, Tylenchorhynchus, Meloidogyne & Dolichodorus were still not detectable within 30 cm of the tube in rhizosphere of either tomato crop. Trichodorus in treated soil was estimated at 50% of the control in the primary crop & at 300% of the control in the double crop. The effect of N-sources, forms & rates were compared on plant growth, yield & fruit quality of drip irrigated tomatoes grown with the full-bed mulch system. Nitrogen sources & combinations were 80% ND(3) + 20% NH(4) or 25% NO(3) & 75% NH(4). Nitrogen forms were 100% liquid injected through the trickle tube, 20% pre-plant dry + 80% liquid & 33% pre-plant dry + 67% liquid. Rates were 185, 230 and 275 kg ha- N. No significant differences in plant growth, fruit yield and fruit quality were associated with any of the treatments. Water movement monitored for different application rates in a moist soil profile (EauGallie fine sand) indicated lateral movement from an emitter was limited to 20-25 cm from the emitter when maintaining applied water within the top 25 cm of the profile.

Publications: 87/10 to 88/09

CSIZINSZKY, A.A. and STANLEY, C.D. 1987. Sequential cropping of vegetables with combined seep and drip irrigation. HortScience 22:1052. (Abstr.).

CLARK, G.A., STANLEY, C.D. and SMAJSTRLA, A.G. 1987. Micro-irrigation on mulched bed systems: components, system capacities, and management. IFAS, Univ. of Fla., Bull No. 245.

CSIZINSZKY, A.A., STANLEY, C.D. and OVERMAN, A.J. 1987. Response of two tomato cultivars to irrigation systems, fertilizer sources, and plant spacings for three consecutive seasons. Proc. Soil and Crop Sci. Soc. Fla. 46:1-4.

CSIZINSZKY, A.A. and STANLEY, C.D. 1987. Effect of nitrogen source and plant spacing on cauliflower production with trickle irrigation. Proc. Soil and Crop Sci. Soc. Fla. 46:84-88.

OVERMAN, A.J., CSIZINSZKY, A.A., JONES, J.P. and STANLEY, C.D. 1987. Efficacy of metam sodium applied via drip irrigation on tomato. Proc. Soil and Crop Sci. Soc. Fla. 46:4-7.

OVERMAN, A.J. and HARBAUGH, B.K. 1988. Water use in caladium tuber production. Proc. Fla. State Hort. Soc. (In Press).

OVERMAN, A.J. 1988. Chemigation for a second crop of tomato on micro irrigated sandy soil. ESN 19th International Nematode Symp. Nematologica 34: (In Press). (Abstr.).

12.020* CRIS0096068

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING VEGETABLE CROPS

WEINGARTNER D P; Agr Res Cntr; University of Florida, Hastings, **FLORIDA** 32045.

Proj. No.: FLA-HAS-02494 Project Type: STATE
Agency ID: SAES Period: 10 JUL 85 to 30 SEP 90

Objectives: a) Investigation of the biology and host-parasitic relationships of phytoparasitic nematodes associated with vegetable crops grown in Florida. b) Evaluation and development of management strategies designed to reduce economic losses due to nematodes attacking vegetable crops.

Approach: Effects of different nematicide combinations, cover crops and other management options on nematode control will be studied.

Progress: 87/10 to 88/09. At harvest population densities of Meloidogyne incognita observed during 1988 in potato research plots at Hastings were the greatest record here. Many plots had 4-6000 nematodes cm soil. The following nematicides applied in 38 x 8 M plots (( ) indicate rates ha in-the-row, 102 cm spacing): 1,3D (56 1 applied using one chisel row), aldicarb 15G (3.36 kg) (A), metham sodium (187 1) applied using 2 chisels row) (MS), 1,3D + A, and MS + A resulted in respective Size A tuber yields of 21.4, 45.7, 38.6, 60.4, and 79.3% over those of nontreated controls. Increasing the rates of MS from 187 to 374 or 561 1 ha failed to improved nematode control and yields of Size A tubers over those of the lowest rate.

Publications: 87/10 to 88/09

WEINGARTNER, D.P. and SHUMAKER, J.R. 1988. In row injection of metham sodium and other soil fumigants for control of nematodes and soil borne potato disease in Florida. Am. Pot. J. 65:504.

12.021 CRIS0096069

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING VEGETABLE CROPS

RHDADES H L; Central Fla Res & Ed Center; University of Florida, Sandford, **FLORIDA** 32771.

Proj. No.: FLA-SAN-02494 Project Type: STATE
Agency ID: SAES Period: 10 JUL 85 to 30 SEP 90

Objectives: Investigation of the biology and host-parasitic relationships of phytoparasitic nematodes associated with vegetable crops grown in Florida. Evaluation and development of management strategies designed to reduce economic losses due to nematodes infecting vegetable crops.

Approach: Determine the nematode species associated with vegetable crops. Investigate 1) their life cycle activities; 2) their host range; 3) influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicides in field studies and evaluate according to yield phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 87/10 to 88/09. In Myakka fine sand infested with the sting nematode, Belonolaimus longicaudatus, and the lance nematode, Hoplolaimus galeatus, in-row

treatments of the soil fumigants, 1,3-D and metam-sodium applied at 56 L/ha and 280 L/ha, respectively, significantly reduced populations of the nematodes and increased yields of 'Early Snowball A' cauliflower; the nonfunigant nematicides, carbofuran, ethoprop, fenamiphos, and terbufos applied at 3.36 kg ai/ha in-row also significantly increased yield of cauliflower, but only fenamiphos and terbufos reduced sting nematode populations and none affected populations. The same treatments applied to 'Harvester' snap bean under very similar conditions resulted in significantly increased yield for all chemicals. The stubby-root nematode, Paratrichodorus christiei, reproduced rapidly and caused root injury on 'Great Lakes' lettuce when added at the rate of 1000 nematodes to single seedlings transplanted in 15-cm pots of steamed Myakka fine sand; however, top growth was not significantly affected.

Publications: 87/10 to 88/09
NO PUBLICATIONS REPORTED THIS PERIOD.

12.022 CRIS0135742
BIOLOGICAL CONTROL OF THE SWEETPOTATO WEEVIL: PATHOGENICITY AND EFFICACY OF ENTOMOPATHOGENIC NEMATODES

JANSSON R K; CRUZ C; GAUGLER R; Tropical Research & Education Center; University of Florida, Homestead, **FLORIDA** 33031.
Proj. No.: FLA-HOM-02756
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 89

Objectives: Isolate and identify endemic entomopathogenic nematodes species in soils of southern Florida and the Caribbean basin; determine virulence of several known nematode species and strains to sweetpotato weevil; determine optimal environmental conditions required for maximum infection of the weevil; determine efficacy of the most virulent strains of nematodes at managing sweetpotato weevil in southern Florida and Puerto Rico; determine the persistence of the most virulent strains in the field.

Approach: Isolate nematodes using Galleria melonella (L) Larval traps; conduct laboratory experiments (petri dish bioassays, apply nematodes to soil above buried sweet potato roots infested with weevil larvae and pupae) and controlled-environment experiments (temperature, humidity, soil moisture) to determine virulence and optimal conditions for infection; conduct field experiments & compare results to those obtained with insecticides. Survey soil for persistence.

12.023 CRIS0142676
NEMATODE AND DISEASE CONTROL ON MINOR FOOD CROPS AND ORNAMENTALS

JOHNSON A W; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 0500-21010-007-52D
Project Type: INHOUSE
Agency ID: ARS Period: 09 FEB 88 to 08 FEB 93

Objectives: To evaluate the effectiveness and phytotoxicity of nematicides and fungicides for control of nematodes and diseases on minor food crops and ornamentals in the South.

Approach: Field and/or greenhouse tests will be conducted under good laboratory/fieldprocedures to determine the effects of nematicides and fungicides on nematodes and diseases of minor crops and ornamentals. Nematode populationswill be monitored and disease damage, crop response and yields will be recorded. Mature fruit and/or plant parts will be analyzed for pesticide residues. Plant species, chemicals and treatment rates are determined by Minor Use Pesticide protocols. Date will be summarized, analyzed, and reports will be submitted to IR-4 Headquarters to support registration for nematicides and fungicides on minor food crops and ornamentals.

12.024 CRIS0048234
NEMATODE CONTROL ON MINOR CROPS

JOHNSON A W; Agricultural Research Service; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 0500-21010-007-23D
Project Type: INHOUSE
Agency ID: ARS Period: 09 FEB 83 to 09 FEB 88

Objectives: Evaluate nematicides for nematode control on minor crops..

Approach: Field and/or greenhouse tests (using standard IR-4 format) will be conducted to determine the effects of nematicides on nematodes on minor crops. Nematode populations will be monitored and crop response and yields will be recorded. Mature fruit will be analyzed for pesticide resideus (See CRIS 7702-20287-003 for pesticide analysis provisions). Data will be summarized, analyzed, and reports will be submitted to IR-4 Headquarters to support registration for nematicides on minor crops..

Progress: 87/01 to 87/12. Additional data on nematicide and fungicide efficacy and residue are needed to support registration on minor crops. Experiments were conducted under field conditions and data were collected for the following projects (PR/pesticide/crop/pest): PR888/fenamiphos/ snapbean/nematodes; PR3180/fenamiphos (applied via irrigation water)/limabean/nematodes; PR3181/fenamiphos (applied via conventional method)/limabean/nematodes; PR3182/fenamiphos (applied via irrigation water)/cowpea/nematodes; and PR3183/fenamiphos (applied via conventional

method)/cowpea/nematodes. Samples have been sent to designated laboratories for pesticide residue analysis. Data from these projects have been submitted to IR-4 Headquarters as part of a National IR-4 Minor Use Pesticide Program and will be used to support registration of pesticides on minor crops.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

12.025 CRIS0140338
NEMATODE AND INTEGRATED PEST MANAGEMENT SYSTEMS FOR THE SOUTHEASTERN COASTAL PLAIN

JOHNSON A W; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 6602-24000-007-00D
Project Type: INHOUSE
Agency ID: ARS Period: 02 AUG 85 to 01 AUG 90

Objectives: Develop integrated pest management systems and models that are effective, energy efficient and economically suitable for managing and predicting populations of plant-parasitic nematodes in intensive vegetable and agronomic cropping systems under irrigation.

Approach: Field tests (using standard and new techniques) will be conducted to determine the effects of cultural practices, crop rotations, cover crops, resistant varieties, tillage methods, irrigation, chemicals and levels of pest management on nematodes, soil-borne fungi, insects, and weeds on intensive horticultural and agronomic crop production systems. Nematode population densities, root-gall indices, seedling diseases, crop response, yield and quality will be recorded. The fate and efficacy of nematicides in soil and groundwater will be determined. The research will be conductedin cooperation with agricultural engineers, agronomists, horticulturists, economists, entomologists, plant pathologists, weed scientists, modelers, and research chemists.

Progress: 87/01 to 87/12. Numbers of root-knot nematode juveniles in intensive cropping systems were <5/150 cc soil in all plots of vegetable crops, except onion and cowpea, following tobacco, and lettuce following sweet corn. The nematode species were 100% Meloidogyne incognita on onion and lettuce, and 70% M. incognita and 30% M. arenaria on cowpea. Numbers of root-knot nematodes were <25/150 cc soil in plots of soybean, cotton, peanut and winter oats prior to planting spring crops. Yields of millet, a potential new crop for the Southeast, were 74% greater in nonirrigated plots treated with fenamiphos and low fertility than yields from similar irrigated treatments. Risk efficient action thresholds have been developed for lesion nematodes on corn. The GLEAMS model (Groundwater Loading Effects of Agricultural Management Systems) was modified to simulate the generation and degradation of pesticide metabolites. GLEAMS-simulated mass of fenamiphos, f. sulfoxide, and f. sulfone in the rhizosphere compared favorably with field data within the variability of observed data. Results from a field test to determine the efficacy of fenamiphos (73.1% in propylene glycol) mixed with Terpine (Unitrol 90) in a 1:1 ratio and fenamiphos (3 SC) applied at 3.3 and 6.6 kg/ha through an irrigation simulator with 0.62 cm of water indicated that lower dosages of fenamiphos and different formulations may provide adequate nematode control, optimum yield, and reduce potential for soil and groundwater pollution.

Publications: 87/01 to 87/12

BURTON, G.W., and JOHNSON, A.W. 1987. Coastal bermudagrass rotations for control of root-knot nematode. J. Nematol. 19:138-140.
JOHNSON, A.W. et al. 1987. The biologic and economic assessment of registered fumigants. USDA Series. 169 pp.
PAYAN, L.A., JOHNSON, A.W., and LITTRELL, R.H. 1987. Effects of nematicides and herbicides alone or combined on Meloidogyne incognita egg hatch and development. Annals of Applied Nematology 1:67-70.
JOHNSON, A.W. et al. 1987. Bibliography of estimated crop losses in the United States due to plant-parasitic nematodes. By: Society of Nematologists Crop Loss Assessment Committee. J. Nematol. 1:6-12.
JOHNSON, A.W. 1987. Nemagation via overhead irrigation. J. Nematol. 19:533. (Abstract).
JOHNSON, A.W., CSINOS, A.S., GLAZE, N.C., and GOLOEN, A.M. 1987. Cochemigation for multiple pest control on tobacco. J. Nematol. 19:533. (Abstract).
JOHNSON, A.W. et al. 1987. Nematicides - A Historical Review. IN J.A. Veech & O.W. Dickson (Eds.) Vistas on Nematology: A Commemoration of the 25th Anniv. of the Soc. of Nematol. pp. 448-454. E.O. Painter Prtg. Co., De Leon Springs, FL.

12.026 CRIS0089017
SPECIFIC CULTURAL PRACTICES FOR PRODUCTION OF POTENTIALLY IMPORTANT VEGETABLE CROPS IN GEORGIA

BATAL K; Horticulture; University of Georgia, Tifton, **GEORGIA** 31794.
Proj. No.: GE000366 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 83 to 31 DEC 88

Objectives: Determine most productive cultivars of selected vegetables adaptable to Georgia soil and environmental conditions. Establish guidelines for proper cultural practices, including the use of protective structures and environmental modification tehniques, affecting productivity and quality.

Approach: Greenhouse and field evaluations of various cultures will be conducted by varying planting methods, population densities, and planting dates throughout the year. Different levels of macro- and micro-nutrients will be tested under different irrigation regimes using various fertilizer sources and formulations. Soil and tissue analyses will be made to monitor soil fertility - pH changes in conjunction with elemental uptake and composition of the plants at different stages. Harvesting times and methods will be varied

according to maturity stages of each crop, and pre- and post-harvest physiological and environmental factors affecting yield and quality will be examined. Environmental modifications will be imposed by using protective covers, misting/shading combinations, and planting patterns.

Progress: 87/01 to 87/12. Studies in transplant production suitable for mechanical automation systems are being conducted. Physical strength of tomato seedlings was improved significantly by subjecting plants to 660 ppm CO(2), Cycocel (CCC), and 20-27 C (night-day) temperature regimes. The treatments resulted in 15% earlier fruit maturity compared to plants grown under ambient CO(2) concn. Seedling heights were reduced more than 50% by either 7 C drop in average temperature or by application of CCC. Effects of controlled N release on vegetable crops are being studied. Higher N rates at 157-202 Kg/ha inreased total yields of tomato fruit regardless of N source. Calcium nitrate applications improved quality by reducing % of fruit with blossom-end rot. Sulfur-coated urea at 202 Kg/ha increased yields in the range of 33-58 MT/ha, compared to 12.7 MT/ha from no N treatments. Phase-I of the tri-state regional project studying sequential planting and cultivar evaluations is being analyzed for 7 locations. Eight of the 11 crops tested in these locations can be economically produced and marketed from April to the end of December. Successive production regimes for the region are being established, based on diversity of climate and soil conditions for each location. Six, 8 and 14 cvs of broccoli, cauliflower, and Chinese cabbage, respectively, have been selected from various sources and were considered excellent choices for commercial production in south Georgia.

Publications: 87/01 to 87/12

BATAL, K.M. 1987. Cultivar demonstration plots evaluated and summary: selected cruciferous crops.- Proceedings of the 1986 Crucifers Improvements Conference, 1986:43-50.

BATAL, K.M. 1987. Special Reports: Multiple Cropping. 1987 biennial report of vegetable research in the southern United States, Hawaii, and Puerto Rico, 1987:p.73.

BREWER, H.L., BATAL, K.M., JONES, P., JONES, J.W. and ALLEN, L.H., JR. 1986. Raising short sturdy seedlings to facilitate automated handling. (abst.): Paper No. 86-4061. 1986 Summer Meeting of American Society of Agricultural Engineers.

BATAL, K.M., BREWER, H.L., JONES, P.T., JONES, J.W., SMITTLE, D.A. and ALLEN, L.H., JR. 1986. CO(2)-Enrichment and temperature effects on seedling quality, growth parameters, and yield of tomato. (abstract). HortSci. 21(3):678.

BATAL, K.M., GRANBERRY, D.M. 1986. Effects of controlled-release nitrogen on tissue composition, yield, and quality of staked-tomatoes. (abstract) HortSci. 21(3):739.

12.027* CRIS0135108

MAXIMIZING THE UTILITY OF ENTOMOGENOUS PATHOGENS IN CROP PRODUCTION SYSTEMS

GARDNER W A; Entomology; University of Georgia, Griffin, **GEORGIA** 30223.

Proj. No.: GEO01419 Project Type: HATCH
Agency ID: CSRS Period: 01 AUG 88 to 31 JUL 91

Objectives: Quantify the impact of agrichemicals, soil antagonists, and target pest movement patterns on the persistence, stability, and efficacy of entomogenous fungi and nematodes in selected soils; determine and analyze biotic and abiotic factors that regulate natural epizootics of entomopathogens; evaluate methods to enhance the activity of the bacterium Bacillus thuringiensis against polyphagous lipidopteran pests; screen and manipulate pathotypes of selected entomogenous fungi to yield isolates resistant to antagonistic agents.

Approach: Laboratory, greenhouse, and field studies will investigate the impact of herbicides and soil microorganisms on the survivorship of entomogenous fungi and nematodes. Beauveria bassiana, Steinernema, and Heterorhabditis will serve as models. Regression procedures will be used to define key factors governing epizootics of entomogenous fungi. Controlled laboratory and greenhouse studies will further delineate the role of environmental factors in their epizootiology. Dose/mortality responses, feeding inhibition, and foliage consumption will be measured in laboratory studies. Field trials of efficacy will follow. Repeated subculturing and induced mutagenesis will be utilized to select for increased resistance of B. bassiana to antagonistic herbicides.

12.028 0139714

BIOLOGICAL CONTROL OF LIRIOMYZA LEAFMINERS WITH ENTOMOPATHOGENIC NEMATODES

HARA A H; KAYA H K; GAUGLER R; Entomology; University of Hawaii, Honolulu, **HAWAII** 96822.

Proj. No.: HAW00972-G
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 89 to 30 JUN 90

Objectives: Isolate naturally-occurring entomopathogenic nematodes in Hawaiian soils and determine their pathogenicity to Liriomyza spp. Genetically select a nematode strain for enhanced host preference to Liriomyza spp. Determine laboratory and field efficacy of naturally-occurring and genetically-modified nematodes. Integrate chemical insecticides, parasitoids and nematodes in a compatible manner for effective management of Liriomyza spp. and other pests.

Approach: Ecologically diverse soils of the major Hawaiian Island will be sampled in an attempt to isolate naturally-occurring entomopathogenic nematodes. Series of laboratory assays will be conducted to determine the concentration and strain of

infective stage nemtodes likely to achieve high rates of Liriomyza mortality in the field. Foliar and drench applications of nematodes against Liriomyza and other insect pests will be conducted in greenhouse and field conditions.

12.029 CRIS0001186
PLANT PROTECTION AND ADAPTATION OF TOMATO, EGGPLANT, AND PEPPER

TAKEOA K Y; SEKIOKA T T; Horticulture; University of Hawaii, Honolulu, **HAWAII** 96822.
Proj. No.: HAW00865-H Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 88 to 30 SEP 91

Objectives: Combine bacterial wilt and multiple disease resistance and large good fruit quality for tomato. Breed eggplant cultivars that are resistant to bacterial wilt and adapted to Hawaii's growing conditions. Oevelop plant protection for peppers by breeding cultivars resistant to tobacco mosaic virus, potato virus Y, bacterial wilt, and root-knot nematode.

Approach: Segregating populations will be inoculated with TMV and grown to maturity in fields carrying BW, root-knot nematode, Pythium and Rhizoctonia fruit rot at all seasons. Wider adaptability, earliness, fruit size, and yield will be sought, including the use of new F(1) hybrids. The pedigree backcross method of breeding will be used to incorporate disease resistance and improve traits in tomato, eggplant, and pepper.

Progress: 86/10 to 87/09. Tomato - The FY87 work on tomato improvement involved selection for firm fruit in the F3 generation. Twenty-four tomato lines were planted with thirteen selections made since most of the lines segregated for fjrmness of fruits. Due to the high night temperatures, flavor of most fruits were bland. EGGPLANT - Four bacterial wilt lines were grown during June - August when day temperatures were consistently 32 C. All lines showed good resistance to bacterial wilt. After fruiting, the field had a high infestation of thrips which caused all the plants to lose their leaves. Seven selections were made based on fruit set, size, shape and skin color. Replicated yield trial of new F1 hybrid eggplants was conducted and completed at the Waimanalo Research Farm. All the Nitta hybrids outyielded the local commercial eggplants. Fruits of the hybrids were all dark purple/black and averaged 25.4 cm in length and better than 3.2 cm in diameter. Hybrid seeds of all hybrids were made for farmers trial. PEPPER - This was an exceptional hot summer with temperatures exceeding 32.2 C almost everyday. Although the peppers grown showed good resistance to bacterial wilt in previous plantings, it was found the type of resistance in line 74P-23 is more effective when temperatures do not exceed 29 C. The range of adaptation for the bacterial wilt resistant pepper has not been fully determined. Over 90% of the peppers planted died from bacterial wilt. Selections were made from the few remaining plants which showed no sign of bacterial wilt.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTEO THIS PERIOO.

12.030 0137864
CHARACTERIZATION OF THE MI LOCUS CONFERRING RESISTANCE TO MELOIDOGYNE INCOGNITA IN TOMATO

WHITE F F; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00792 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 89 to 30 SEP 92

Objectives: Analyze the restriction fragment length polymorphisms (RFLP) in the region of the mi locus to determine the extent of alien ONA introgression in tomato. Since mi is apparently linked to the locus for isozyme 1 of acid phosphatase (aps1), RFLP probes are sought for the aps1 locus. A test for nematode susceptibility on transgenic roots is to be established. The amount of alien DNA that can be transferred to roots will be analyzed. The role of superoxide dismutase in nematode resistance will be examined.

Approach: RFLP probes will be used to analyze the extent of Lycopersicum peruvianum ONA in nematode resistant tomato lines (Lycopersicum esaulentum). Additional probes are to be obtained from the chromosomal region of the mi gene. Probes will be prepared and used in laboratory techniques including ONA isolation, northern and Southern blot hybridization analyses, protein purification, and ONA cloning. Plant testing will involve inoculation with nematodes and Agrobacterium-media seedplant transformation.

Progress: 89/01 to 89/12. Toward the use of Aegrobacterium rhizogenes in studying resistance to M. incognitie, the root-inducing genes of A. rhizogenes have been characterized. RolB has the pedioate role in root inductions. However, rolC is important for in vitro root growth. Thus, for root induction, bacterial strains with rolB (and virulence genes) are sufficient for transgenic root-induction and subsequent nemotode infection testing. RolC is required for in vitro root/nematode culture.

Publications: 89/01 to 89/12
NO PUBLICATIONS REPORTEO THIS PERIOO.

12.031 CRIS0003145
OKRA BREEDING AND PRODUCTION

FONTENOT J F; BREWER H M; PICHA O H; Horticulture; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB00820 Project Type: STATE
Agency IO: SAES Period: 01 JAN 86 to 31 OEC 90

Objectives: RESEARCH OBJECTIVES ARE 1) HIGH YIELO; 2) IMPROVEO POO TYPES AS TO SHAPE, COLOR, LENGTH, CULINARY QUALITY ANO SPINELESSNESS; 3) IMPROVEO POO SHIPPING ANO STORAGE QUAITY; 4) IMPROVEO PLANT AND POO TYPES

SUITABLE FOR MECHANICAL HARVEST; 5) FUSARIUM WILD RESISTANT; 6) NEMATDDE RESISTANT AND 7) DRDUGHT RESISTANT. DUR PRIMARY AIM IS TD DEVELDP BETTER OKRA CULTIVARS FDR CDMMERCIAL PRDDUCTIDN AND HDME GARDENS.

Approach: DIVERSE GENETIC STDCK WHICH PDSSESSES GENES DF DESIRED CHARACTERS WILL BE USED AS PARENTAL LINES AND HYBRIDIZATIDNS WILL BE MADE IN THE FIELD. THE PEDIGREE, MASSPEDIGREE AND BACKCRDSS METHDDS DF BREEDING WILL BE USED. ALL ADVANCED LINES WILL BE SCREENED FDR THE ABDVE DBJECTIVES AND STANDARD STATISTICAL METHDDS WILL BE USED TD DETERMINE TRUE DIFFERENCES IN FIELD AND LABDRATDRY EXPERIMENTS.

Progress: 87/01 to 87/12. The horticultural characteristics that our advanced lines and plant introductions were scored on were adaptability, uniformity, yield potential, maturity, plant size, plant habit, foliage, fruiting habit, pod (shape, color, size and spines). The following lines were identified with no spines: PI22, PI30, PI40, and PI41. Selections classified as dwarfs were PI10, PI38, PI37, PI42, PI57, PI66, L31, L33, L35, L54, L67, L76, L90, L91, L98, L112, and L120. Lines best in overall rating were PI30, PI35, PI51, L30, L52, L70, L78, L90, and L111. A replicated cultivar trial was conducted and it was noted that Emerald was the earliest in production. The top yielding entries in this experiments were L.S.U. Gold Coast, Emerald, Annie Dakley, Clemson Spineless, and Louisiana Green Velvet. Studies were conducted to determine the effects on okra pod shelf-life by storage in polyethylene bags. Pods of three cultivars of okra were placed in 1.6 mil polyethylene bags or kept i open air and stored at room temperature (24 to 25 C). The pods that were not stored in bags were rated unacceptable 24 hours after harvest.

Publications: 87/01 to 87/12

FDNTENDT, J.F., WILSON, P.W., BUTTS, K., SHUH, D.M. and BREWER, H.M. 1987. La. Agriculture 30:16-18.

FDNTENDT, J.F., BREWER, H.M. and WILSDN, P.W. Department of Horticulture Progress Report December 1986:10-11.

12.032 CRIS0003134
TOMATO BREEDING

RANDLE W M; CDNSTANTIN R J; ETZEL W W; Horticulture; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB00719 Project Type: STATE
Agency ID: SAES Period: 12 JAN 35 to 31 DEC 86

Objectives: Breed new varieties for fresh and processing markets and dwarf patio types with following desirable characteristics: High yield, uniform shape, and well-colored fruit, good culinary quality, fruit crack resistance, large fleshy fruit, plants with good foliage and heat resistance, multiple resistance to diseases and insects. Select tomato types for mechanization, for good combiningability for production of F(1) hybrids, and study mode of inheritance of genetic characters.

Approach: Crosses, backcrosses, and intercrosses shall be made to incorporate good horticultural characters into a good varitty and for genetic study. Combining ability of parents in F(1) hybrids will be evaluated.

Progress: 76/01 to 86/12. The major effort of this project has been the development of open pollinated cultivars for spring and fall harvest which combine good fruit quality with disease resistance. Also included would be heat and tolerance to fruit set. Three breeding lines have shown potential for cultivar release: L243, L462 and L386. All three are for spring production. A randomly mating tomato population designed to break the linkage between small fruit and fruit set at high ambient temperatures was carried through 4 cycles and selections were made. These selections were to be intermated to complete the 1st cycle of recurrent selection for heat tolerance to fruit set.

Publications: 76/01 to 86/12
ND PUBLICATIDNS REPDRTED THIS PERIDD.

12.033 CRIS0140833
INTEGRATE BEHAVIORAL STUDIES WITH BIOCONTROLS AND CHEMICALS TO CONTROL MUSHROOM FLIES

CANTELD W W; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-054-00D
Project Type: INHDUSE
Agency ID: ARS Period: 01 APR 86 to 30 MAR 91

Objectives: Identify the allelochemics used by phorid and sciarid flies to locate host materials. Evaluate practicability of using bacteria, Bacillus spp., and the nematode, Steinernema feltiae for fly control. Determine fly colonization patterns in mushroom growing media.

Approach: Volatiles from different stages of mushroom composting will be trapped, fractionated, and tested for attraction by each fly species, and the active fractions identified. The attractants will be tested as surveillance and control tools. Nematodes and bacteria will be evaluated as fly control agents to determine fly response to various dosages and application techniques. Preferred sites for mushroom fly oviposition will be identified by field sampling and laboratory tests, and chemical factors responsible for this preference sought. The horizontal and vertical distribution of immature flies in a growing room will be ascertained by laboratory studies and field sampling of media.

Progress: 87/01 to 87/12. Evaluation of the efficacy of insecticides applied as compost or casing for control of the sciarid fly was completed. Several insect growth regulators were found to produce excellent control. Two crops were grown to evaluate these materials for phytotoxicity as compost treatments at the LD95 dosage level and at 3X that level. Phytotoxicity was evident with only one material. Certain strains of parasitic nematodes showed great promise as biocontrol

agents for the mushroom flies. The 3rd instar of the sciarid fly was the most susceptible to nematode attack. Under proper conditions, nematodes could survive and remain infectious for 2 weeks or more. The research has the potential to develop new biological control technology and a better utilization of insecticides. Major users of the research are the mushroom growers and the mushroom industry.

Publications: 87/01 to 87/12

CANTELO, W.W. Advances in control of the sciarid fly, Lycoriella mali (Fitch). Mushroom Sci. 12. ACCEPTED June 15, 1987.

CANTELO, W.W. Movements of Lycoriella mali (Diptera:Sciaridae) through mushroom growing medium. J. Economic Entomol. 80: ACCEPTED July 8, 1987.

12.034 0143918

NATURAL BIOREGULATORS & ANALOGS OF PLANT PARASITIC NEMATODES-NEW ENVIRONMENTALLY SAFE NEMATICIDES

HUETTEL R N; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-065-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 89 to 31 MAR 90

Objectives: 1) Determine effects of pheromones and analogs of soybean cyst nematode under greenhouse and field conditions; 2) isolate sex and other pheromones from other bisexual cyst nematodes; 3) develop bioassays to understand pheromones that effect sex change in parthonogenetic nematodes.

Approach: Develop and improve bioassays for detection of pheromones, utilize control release formulations, such as alginated pellets for application of pheromone and analogs to greenhouse and field, use in vitro tissue culture techniques to develop bioassays to test for sex change pheromones.

Progress: 89/10 to 89/12. A patent was completed, approved by the USDA Patent Committee and is in the process of being filed on the soybean cyst nematode sex pheromone and thirteen of its analogs. Greenhouse studies continued on the use of these compounds in alginated pellet formulations to reduce nematode populations with 6 out of 14 analogs completed. The use of these compounds may provide new environmentally safe compounds for commericial use to control soybean cyst nematodes. A study on the affect of root-knot nematodes on scion cultivars of peach propagated in vitro, the greenhouse and in microplots was completed. The results indicated that the response of peaches to nematodes at five weeks in vitro is the same as observed for in vitro propagated peaches grown in the greenhouse and under field conditions. The cultivar "Compact Red Haven" appeared to have the best level of nematode tolerance and will be tested in other locations. In vitro growth studies on Pastueria spp. continued. Monoclonal and polyclonal antibodies were developed in cooperation with Rutgers University. New cultivation techniques look very promising. Field plots were established in 1988 and 1989 in an area infested with soybean cyst nematodes that had been used to evaluate resistant soybean germplasm the previous season. A high degree of population spatial heterogeneity is desirable for developing computer models for promotion of alternative control strategies and this was verified both years.

Publications: 89/10 to 89/12

HUETTEL, R.N. 1989. In vitro screening of soybean cultivars to Radopholus similis and R. citrophilus. Nematropica. In Press. Accepted June, 1989.

HUETTEL, R.N. 1898. Monoxenic culturing of plant parasitic nematodes. IN Plant Parasitic Nematodes. Lab Manual. U. MA Agr. Exp. Sta. Amherst, MA. In Press. Accepted May 1989.

HUETTEL, R.N., REISE, R.W. and HENN, A. 1989. A growers guide to plant parasitic nematodes in Maine. Extension Bulletin, University of Maine. In Press. Accepted June 1989.

HUETTEL, R.N. 1989. Aggregate formation in some Pratylenchus spp. Survival Mechanisms. J. Nematol. 21 566. Abstr.

HUETTEL, R.N. 1989. Response of peach scion cultivars and rootstocks to root-knot nematodes in vitro, in the greenhouse, and in microplots. J. Nematol. 21 566. Abstr.

FRANCL, L.J. and KENWORTHY, W.J. 1989. Heterogeneity in population density of soybean cyst nematodes after evaluation of soybean germplasm. J. Nematol. 21 561. Abstr.

12.035 CRIS0049448

PHEROMONES AND NATURAL BEHAVIOR MODIFYING CHEMICAL COMMUNICATORS OF HELMINTHS OF PLANTS

HUETTEL R N; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-028-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 84 to 30 SEP 89

Objectives: To study plant parasitic nematode behavior and observe, isolate and identify natural nematode metabolites and behavior modifying compounds (semiochemicals) that may be used to develop new, safer nematode control and bioregulation strategies.

Approach: Develop and improve xenic cultures of plant parasitic nematodes (particu- larly races of soybean cyst, Heterodera glycines; H. schachtii, sugarbeet cyst; H. zeae, corn cyst; Meloidogyne spp: root knot; Rotylenchulus reniformis, reniform; and Pratylenchus spp. lesion nematodes) to observe their development, behavior responses and reaction to pheromones and other semiochemicals. Develop and improve bioassay methods for the detection, isolation, purification and evaluation of specific pheromones and semio- chemicals. Usechromatographic (HPLC, TLC), electrophoretic (SDS, isoelec- tric focusing), and histochemical techniques to isolate and purify new semiochemicals for chemicalcharacterization and to identify their synthesisand receptor

sites. Compare similarities and differences of specific pheromones and metabolites of races and species cyst nematodes.

Progress: 87/01 to 87/12. A new in vitro screening technique was developed for determining the pathogenicity of migratory plant parasitic nematodes (PPN) to 15 soybean cultivars. Cultivars known to be resistant to cyst and root-knot nematodes (RN) were highly susceptible to PPN, burrowing nematode. Greenhouse and second year field studies of peach propagated from tissue culture show that the in vitro screening of peach to RN at five weeks gives the same results as two years in the field. The results of both these studies will be of value to breeders and researchers for developing new plant varieties. Digestion profiles of total DNA from three races of soybean cyst nematodes (SCN) by eight restriction enzymes were analyzed on agarose gels. The DNA fragment patterns generated by the three races appeared to be of diagnostic importance. A new technique for rapid DNA isolation was described. These studies aid in understanding the systematics of races of SCN and may lead to production of diagnostic kits for industry. Identification of the sex attractant of SCN has been verified by regrowth of SCN on root-explant in ultrapure water. Purification and identification was completed on GC-MS. The use of pheromones as bioregulators may provide industry with new approaches to nematode management.

Publications: 87/01 to 87/12

- HUETTEL, R.N. 1987. In vitro screening of Radopholus citrophilus and R. similis to soybean cultivars. J. Nematol. 18:529. (Abstract)
- HUETTEL, R.N., and JAFFE, H. 1987. Attraction and Behavior of Heterodera glycines, the soybean cyst nematode, to some biological and inorganic compounds. Proc. Helminthol. Soc. Wash. 54:122-125.
- HUETTEL, R.N., and YAEGASHI, T. 1987. Morphological differences between Radopholus citrophilus and R. similis. Accepted by the J. Nematol. 9-15-87.
- REISE, R.W., HUETTEL, R.N., and SAYRE, R.M. 1987. Carrot callus tissue for culture of endoparasitic nematodes. J. Nematol. 19:387-389.
- KALINSKI, A., and HUETTEL, R.N. 1987. Repetitive fragments comparison as a diagnostic assay in detection of races of soybean cyst nematode, Heterodera glycines. Accepted by the J. Nematol. 12-20-87.

12.036 0139667

DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

ZUCKERMAN B M; Plant Pathology; University of Massachusetts, Amherst, **MASSACHUSETTS** 01003.
Proj. No.: MAS00662 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes emphasizing biological and cultural control procedures.

Approach: The focus is on novel nematode biocontrol systems. First is the isolation of nematicidal repellent and/or reproduction inhibiting microbes from naturally nematode suppressive soils. Several organisms isolated thus far have successfully completed greenhouse trials and will be cooperatively field tested with project participants in New York (Abawi) and Connecticut (LaMondia). Second, is the further testing of nematode suppressive legumes. Work thus far has indicated that a lectin given off in root exudates from jackbean acts as a continuous delivery system to repel nematodes.

12.037* CRIS0028875

NEMATODE POPULATION MANAGEMENT IN MICHIGAN CROP PRODUCTION

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL00446 Project Type: STATE
Agency ID: SAES Period: 20 AUG 82 to 19 AUG 88

Objectives: To develop procedures for improved detection of nematodes (plant parasitic and beneficial) and diagnosis of nematode problems associated with selected fruit, vegetable and agronomic crop production systems. To develop procedures for improved production system analysis related to nematode problems; with special reference to nematode sampling and extraction and crop loss assessment. To design and validate integrated nematode management procedures using the principles of exclusion, population reduction and tolerance.

Approach: Most of the research associated with this project will deal with three model nematode species: Pratylenchus penetrans, Meloidogyne hapla and Heterodera schachtii. Xiphinema americanum, Longidorus breviannulatus, Criconemella xenoplax, Heterodera trifolii and Meloiodgyne nataliei will be investigated on a more limited basis. Field, greenhouse, growth chamber and laboratory experiments will be used to design improved nematode sampling, extraction and crop loss assessment procedures. A broad array of nematode control procedures will be validated under both field and controlled conditions.

Progress: 87/01 to 87/12. The 1987 research program concentrated on management of nematode problems of carrot, potato, cherry, sugarbeet, soybeans and corn. Heterodera glycines was discovered in Michigan for the first time, and the geographical isolate will attack dry beans. Implementation of previous chemigation research continue to be successful. In a jount MSU project with the Zimbabwe Ministry of Agriculture, maize roots and P. zeae were aggregated at depth 0-20 cm. P. zeae in this study had a Pf/Pi ratio of 170. Very few second stage juveniles were recovered in this study. The optimal time for sampling maize roots for

P. zeae was 4 weeks after planting at depth 10-20 cm and radius of 0-10 cm. The optimal time for sampling soil around maize roots was 2 weeks after planting at depth 10-20 cm and radius 10-20 cm. Maize root growth was adversely impacted at 11.7% gravimetric soil moisture in loamy sand soil and P. zeae population density was only slightly adversely impacted at 5.0% gravimetric soil moisture in the greenhouse study. Carbofuran, fenamiphos, isazofos and terbufos reduced P. zeae in maize roots by 95, 96, 95 and 93% and increased yield by 67, 54, 37 and 66% respectively, and organic amendments reduced P. zeae and increased maize growth and grain yield.

Publications: 87/01 to 87/12

MACGUIDWIN, A.E., BIRD, G.W., HAYNES, D.L. and GAGE, S.H. 1987. Pathogenicity and population dynamics of Meloidogyne hapla associated with Allium cepa. Pl. Dis. 71:446-449.

MUCHENA, P.K. and BIRD, G.W. 1987. Role of fenamiphos as a nemastat for control of Heterodera schachtii in cabbage production. Pl. Dis. 71:552-554.

BURNETT, B. 1986. Effects of the oat cyst nematode on small grains in Michigan. M.S. Thesis. Crop and Soil Science Dept. MSU. E. Lansing. 63 pp.

12.038* CRIS0074948

INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL01306 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs. Determine the relationships among initial nematode population densities and crop yields, and impact of biotic and abiotic stresses on these relationships. Develop and validate predictive crop loss assessment systems. Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Laboratory, tissue culture, system science, growth chamber, greenhouse and field research procedures will be used to evaluate the associations between Pratylenchus penetrans and Solanum tubersum, and Heterodera schachtii and Brassica capitata relation to the four objectives of this project.

Progress: 87/01 to 87/12. During the past several years major research emphasis has been placed on the development of chemigation technology for use by Michigan potato growers. This has now expanded to the muck vegetable, strawberry and ornamental industries. In general on mineral soils, 25 gal/A of metham (sodium N methyl dithiocarbamate) will provide control of Pratylenchus penetrans; whereas, 40-60 gal/A is required for control of the early-die disease complex, and 75-100 gal/A for Verticillium dahliae control. In a three-year potato rotation, only the 100 gal/A rate kept populations of both P. penetrans and V. dahliae at low enough population densities to provide early-die control for a second potato crop. The Michigan geographical isolate of Herodera glycines reproduces on dry beans, and appears to be pathogenic. Heterodera carotae was recovered from 50% of the commercial fields and 19% of the samples in a western Michigan carrot survey. The biology of the MI geographical isolate appears to differ from that reported in the European literature. Meliodogyne nataliei can still be detected in isolated areas of the type location. The Michigan geographical isolate of Heterodera avenae is only mildly pathogenic on local oat and wheat cultivars.

Publications: 87/01 to 87/12

BIRD, G.W. 1987. Role of Nematology in Integrated Pest Management. pp. 114-121 (In) Vistas on Nematology, J. Veech and D. Dickinson (Eds). Society of Nematologists. 509 pp.

BIRD, G.W. 1987. Alternative futures of agricultural pest management. Amer. J. Alt. Agric. 2:25-29.

12.039 CRIS0132230

CONTROL OF HETERODERA SCHACHTII AND CERCOSPORA BETICOLA ON SUGAR BEET IN THE NEBRASKA PANHANDLE

KERR E D; Panhandle Station; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-44-036 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 JUN 92

Objectives: 1. Determination of the relationship between the cyst and egg counts, respectively, and yield loss associated with the sugar beet cyst nematode for western Nebraska. 2. Development of a sugar beet cercospora leaf spot alert system for western Nebraska. 3. Develop cultural and chemical control measures for diseases of major field and vegetable crops in western Nebraska.

Approach: 1. The number of cysts and eggs of Heterodera schachtii in preplant soil samples will be determined. Paired plots will be established with nematicide treatment and no treatment in areas of a field with a wide range of nematode populations. Root & sugar yield at harvest will be compared to initial cyst & egg populations. Economic threshold levels of nematode populations will be determined for advisory use with growers. 2. Sugar beet Cercospora leaf spot infection will be monitored & compared to periods of leaf wetness, relative humidity, & temperature. Periods favorable for infection will be used to establish fungicide advisories for growers. 3. Fungicides & nematicides will be tested in field plots for efficacy in control of sugar beet nematode & false root-knot nematode on sugar beet, lesion nematode on corn, Rhizoctonia root rot on sugar beet, Botrytis blight on onion, and powdery mildew on sugar beet.

Progress: 87/01 to 87/12. An advisory system for application of fungicides to control Cercospora leaf spot on sugar beet was field tested in western Nebraska in 1986 and 1987. Daily infection values (DIV's) were based on Minnesota/North Dakota systems using duration of relative humidity (RH) >90% and mean air temperature. DIV's were determined in this test using duration of leaf wetness and mean canopy temperature derived from sensors on an automated weather station placed in a sugar beet field with a history of severe leaf spot and also from RH >90% and mean air temperatures derived from a hygrothermograph placed in the same location. DIV's favorable for infection were recorded from July 24-August 3 by leaf wetness and canopy temperatures and only on July 31 and August 8 using RH >90% and air temperatures. A test plot on the same location was used to compare fungicide applications starting with favorable DIV's from the two methods and with first leaf spot symptoms. All fungicide treatments were followed by significantly (0.05 level) less leaf spot than an untreated control but differences among fungicide treatments were not significant. Sugar yield was greater from fungicide treated plots than from control plots but the difference was not significant. Hail injury altered yield level and disease severity. Disease severity was very low, as expected from the weather data, and severity did not increase during periods of unfavorable DIV's.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

12.040* CRIS0027934
PLANT DISEASE SURVEY AND SPECIAL INVESTIGATIONS

WYSONG D S; WATKINS J E; BOOSALIS M G; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-21-001 Project Type: STATE
Agency ID: SAES Period: 01 JUL 66 to 13 MAR 89

Objectives: Monitor plant disease occurrence; determine casal agents of new diseases; deliniate geographic distribution of new and recurring diseases on a periodic basis; make preliminary studies on severity of new or certain recurring diseases; develop judments on feasibility of short-term versus long-term investigations on certain diseases.

Approach: Conduct periodic field examinations for diseases on field crops with particular attention to alfalfa, corn, sorghum, soybeans and wheat; record and maintain records of pathogen identification, disease severity and location, host, and other pertinent data; conduct further study of specific plant diseases collected on survey; study applicability of practical control measure for economically important diseases.

Progress: 87/01 to 87/12. SOYBEANS: A soybean cyst nematode (SCN) survey was conducted in an 8-county area bordering the Missouri River between Richardson County on the south and Burt County on the north. A total of 130 soybean fields were included in the survey, which was initiated in late July and completed in mid-August, 1987. Assays of soil and plant roots collected on survey resulted in the identification of 13 "new" infested fields. The number of fields surveyed by county and the number of confirmed SCN fields (in parentheses) is as follows: Richardson - 20 (4), Nemaha - 20 (2), Otoe - 20 (1), Cass 10 (1), Sarpy - 13 (2), Douglas - 7 (1), Washington - 20 (0), and Burt - 20 (2). While all of the infested fields are associated with low-lying, river bottomland soils, four of the fields were located in the central or western sections out of the Missouri floodplain region. Three of these fields were in Richardson and one was in Douglas counties. SORGHUM: A sorghum downy mildew survey was conducted in a 35-county area in south central, east central and southeastern Nebraska in order to determine the incidence and severity of the disease in commercial fields. A minimum of four fields were selected at random in each county. The disease was found to occur in 17 of the 35 counties; it was considered severe and, in a few fields, was felt to be yield-limiting in a four-county area including Nuckolls, Thayer, Fillmore and Clay counties.

Publications: 87/01 to 87/12
POWERS, T. and WYSONG, D.S. 1988. Soybean Cyst Nematode in Nebraska. Crop Prot. Clinic Proc., pgs. 146-148.
JENSEN, S.G., WYSONG, D.S. and DOUPNIK, B., JR. 1988. Sorghum Downy Mildew, The Disease and its Control. Crop Prot. Clinic Proc., pgs. 123-127.

12.041 CRIS0089157
BIOLOGY, EPIDEMIOLOGY & CONTROL OF VIRUSES & MYCOPLASMA-LIKE ORGANISMS CAUSING DISEASES OF CORN

DAVIS R F; Plant Pathology; Cook College, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11230 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: To identify and characterize viruses, spiroplasmas and MLO s occurring in corn and sorghum in the United States and to develop methodology suitable for virus detection in epidemiological studies. To determine the influence of disease cycle components on epidemics of MDMV and MCDV in the U.S.; to identify these components in newly discovered virus and MLO diseases; and to determine the critical components needed to forcast disease occurrences and intensities and involved in the disease cycles.

Approach: Samples of suspect-diseased plant will be collected and the agents will be identified and characterized. Conjugated ELISA reagents will be purchased or produced after purifying the viruses and obtaining antiserum. Conditions for optimum resultus with ELISA will be determined by standard procedures. Collected samples from late planted corn will be tested during winter by ELISA for four common corn viruses. Weeds will be collected around areas where virus incidence appears high and will be tested by ELISA. To monitor the movement of vechor, leafhoppers will be trapped with yellow

sticky traps.

Progress: 87/01 to 87/12. Maize dwarf mosaic virus (MDMV) infected sweet corn plants were detected again this year by indirect enzyme-linked immunosorbent assay (I-ELISA). An overwintering host for strain B of MDMV was not detected. Desiccated corn tissue stored at -10 C for five years was still reactive in I-ELISA.

Publications: 87/01 to 87/12

HUFF, D.E., DAVIS, R.F., and MYERS, R.F. 1987. Longidorus breviannulatus as a vector for brome mosaic virus. Nematology 19:143-145.

12.042 CRIS0083300
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

CHEN T A; MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11282 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs; determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships; develop and validate predictive crop assessment systems; using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Sampling precision will be tested in field and microplots on several genera of plant parasitic nematodes. Microplots will be established using different soil types and similar nematodes and crops. Electron microscopy, histopathology and nematode culturing procedures will be used to study nematode-virus interactions. Economic thresholds will be modeled by computer to predict yield losses from stress factors and edaphic factors.

Progress: 87/01 to 87/12. Tomato ringspot virus (TomRSV) is transmitted in nature to apples and peaches by the dagger nematode Xiphinema sp. In 1987, we have made the following studies: Development of an improved method to purify Tom RSV: Using a modified buffer and density gradient centrifugation three distinct bands were visible and they were collected in a fractionator equipped with a densitometer scanned at 254 nm. 0.79- 0.97 mg of Tom RSV could be obtained from 100 g of diseased plant tissues.Monoclonal antibodies specific against Tom RSV: Monoclonal antibodies to TomRSV have been developed from hybridoma techniques. Spleenic cells obtained from immunized BALB/c mice were fused with murine myeloma cells (NS-1). Specific antibodies produced from hybridomas were screened against TomRSV. Tom RSV-infected plants and healthy uninfected plants using ELISA. Detection of double stranded RNA from Tom RSV-infected plants: Double-stranded RNA was eluted from 10 cm CF-11 cellulose column in STE buffer (0.1 M NaCC, 0.05 M Tris, 0.001 m EDTA, pH 7.0) only from infected squash plants but not from healthy plants. Electrophoresis in polyacrylamide and agarose gels showed three dsRNA species all of which were resistant to treatments with DNAse and RNAse A.

Publications: 87/01 to 87/12

MOHAN, S. and CHEN, T.A. 1987. An improved procedure for the purification of tomato ringspot virus. N.J. Acad. of Science Bulletin 31:12.
MOHAN, S. and CHEN, T.A. 1987. Detection of double-stranded RNA from squash infected with tomato ringspot virus (TomRSV). Phytopathology 77 (In press).
MOHAN, S. and CHEN, T.A. 1987. Absence of 3'polyadenylation in the RNA of a tomato ringspot virus (TomRSV) isolate. Phytopathology 77 (In press).

12.043 0139915
DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

CHEN T A; MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11285 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes; emphasizing biological and cultural control procedures. Evaluate these tactics and integrate effective procedures into practical nematode management programs which minimize crop losses, environmental contamination, and human health risks.

Approach: Develop efficient and specific detection probes for the diagnosis and identify plant viruses transmitted by nematodev ectors. Biotechnology such as hybridoma techniques and gene probes will be used. Attempt to culture in vitro biological antagonists to nematodes, particularly Pastoria sp. The relationship of the nutritional value of plant roots to nematode production will be investigated. A model system consisting of varieties of Kentucky bluegrass or perennial ryegrass and Tylenchorhynchus maximus will be tested to establish if the nematode's reproduction is affected. Biochemical analyses will then be correlated with reproduction rate.

12.044 CRIS0089894
QUANTIFYING THE PARAMETERS OF THE NEMATODE PEST MANAGEMENT DECISION PROCESS

THOMAS S H; Entomology & Plant Pathology; New Mexico State University, Las Cruces, **NEW MEXICO** 88003.
Proj. No.: NM-1-5-27174 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: The effects of edaphic factors on nematode-related crop losses in vegetables, cotton and sorghum will be studied under field conditions. Greenhouse and microplot experiments will be used to rapidly identify germ-plasm-related differences in susceptibility and inoculum influences. The relationship of chemical and cultural control practices to nematode-related crop loss functions will be determined. From this, economic thresholds will be developed for Meloidogyne incognita and Pratylenchus spp. on cotton, sorghum and locally important vegetables.

Progress: 86/10 to 87/12. Acala 1517-E2 cotton and DK 57 grain sorghum yields were reduced 58% and 46% respectively in microplots infested with Meloidogyne incognita host race 3 compared to uninfested plots. Early season plant height was reduced and bloom date delayed in infested sorghum plots, but not in cotton. Aldicarb (1.68 kg a.i./ha) afforded significant control of J2 populations in soil during the first two months of cotton culture, but only 54 liters/ha 1,3-dichloropropene resulted in season-long control in both crops. Net benefits from cotton nematicides (revenue from yield increase associated with nematicide application, less treatment costs) were $274/ha with 1,3-D, $124/ha with fenamiphos (1.85 kg a.i./ha) and $30/ha with aldicarb. Sorghum net benefit was $23/ha with application of 1.12 kg a.i./ha carbofuran, but yield responses with 1,3-D and aldicarb were not cost effective. Residual M. incognita inoculum was 14 x greater in sorghum plots than cotton. Field plot experiments demonstrated a 24% increase in chile pepper yields by increasing depth of placement of 1,3-D from 25 cm (normal placement depth in NM) to 48 cm in sandy loam soils. This results in a $642/ha ($260/acre) increase in net benefit from application. Depth of placement studies were repeated during 1987 and net benefits compared with nonfumigant nematicides. Additional studies were initiated to investigate the interrelationships of phytophagous insects and plant-parasitic nematodes on common host.

Publications: 86/10 to 87/12

ALVAREZ, M.E., SENGUPTA-GOPALAN, C., THOMAS, S., KUEHN, G.D. and KEMP, J.D. 1987. Isolation and characterization of a collagenase that degrades nematode collagen. Proceedings Southwest Consortium on Plant Gentics and Water Resources.

KLUMP, R.S. and THOMAS, S.H. 1987. Comparative resistance of selected Acala 1517 cotton cultivars to Meloidogyne incognita race 3. Annals of Applied Nematology 1:113-115.

THOMAS, S.H. and MURRAY, L. 1987. Yield reductions in grain sorghum associated with injury by Meloidogyne incognita race 3. J. Nematology 19:559. (Abstract).

THOMAS, S.H. 1987. Nematodes in chile: enhancing control by increasing placement depth of Telone II. Proceedings New Mexico Chile Conf.

THOMAS, S.H. and SHANNON, E.L. 1987. Nematode disease losses in New Mexico cotton. Proceedings Beltwide Cotton Production Research Conferences. P. 10.

12.045 CRIS0136644

TAGGING PLANT GENES WITH TIGHTLY-LINKED RFLP MARKERS

TANKSLEY S D; YOUNG N D; Plant Breeding & Biometry; Cornell University, Ithaca, **NEW YORK** 14853.

Proj. No.: NYC-149309 Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 88 to 31 AUG 91

Objectives: PROJ. 8800445. The objective of this research is to find single copy RFLP markers that are tightly linked to several disease resistance genes in tomato. Included in this list of genes are Mi (root-knot nematode resistance), Ve (Verticillium wilt resistance), I/I2 (Fusarium wilt resistance, races 1 and 2) and Tm1/Tm2 (tobacco mosaic virus resistance). Tightly-linked RFLP markers will be oriented into fine structure maps around each resistance gene using pulsed-field electrophoresis. The long-term goal is to develop a map-based cloning strategy which can be used to isolate these and other genes whose gene products are unknown via their position on a saturated RFLP map.

Approach: Tightly-linked RFLP markers will be identified from a single copy genomic library by rapidly testing multiple clones against nearly-isogenic lines. Using this technique, up to 10 clones can be tested simultaneously and we expect to screen 1000-2000 clones during the funding period of this grant. Direct mapping of clones found to be linked to a disease resistance gene will be accomplished using F2 and backcross populations segregating for each gene. Field inversion and CHEF electrophoresis will be employed for physical mapping.

12.046* CRIS0060493

ECOLOGY AND CONTROL OF PLANT PARASITIC NEMATODES

MAI W F; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.

Proj. No.: NYC-153429 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 31 DEC 87

Objectives: The overall objective is to develop and improve integrated control procedures for nematode diseases and complex root diseases caused by nematodes and othr osil organisms which will not result in harmful residues in food, be detrimental to the environment, or injure growers. More specific objectives are to when appropriate, determine distribution of plant-parasitic nematode species and pathotypes, to further study the etiology of

complex diseases and interactions among the causal organisms and other factors, to determine damaging levels for nematode and complex diseases of fruits and vegetables and determine biological and abiotic factors influencing these levels.

Approach: Distribution of nematode species and pathotypes will be determined by surveys of growers' farms. Cost/benefit analyses of control strategies will be constructed using data from experiments on growers' farms. In cooperation with G.W. Bird, Michigan State and G.S. abawi. Geneva Agricultural Experiment Stateion a crop loss assessment model for Heterodera schachtii will be designed. Damaging and economic threshold levels for nematode and complex diseases will be determined in microplot experiments.

Progress: 87/01 to 87/12. The influence of maturity of cabbage at time of harvest on the effect of 3 initial inoculum levels (Pi's) of Heterodera schachtii (Hs) on total and marketable cabbage yields was studied in microplots. Harvests were made at 75, 90, and 105 days after harvest. Yield (total and marketable) reductions at all Pi's was reduced by delayed harvest. However, delaying harvest by up to 30 days did not result in complete recovery of infected plants. Ten, 20, and 40 eggs/cc soil reduced marketable yield by 34, 51, and 62% respectively, in the first harvest and only by 15, 23, and 36% at the last harvest 30 days later.

Publications: 87/01 to 87/12

COSTANTE, J.F., MAI, W.F., ALEONG, J. and KLEIN, R.M. 1987. Effects of apple rootstocks and nematicides on Pratylenchus penetrans populations and apple tree growth. J. Amer. Soc. Hort. Sci. 112:441-444.

MAI, W.F. and ABAWI, G.S. 1987. Interactions among root-knot nematodes and Fusarium wilt fungi on host plants. Ann. Rev. Phytopathol. 25:317-338.

ZUCKERMAN, B.M., MAI, W.F. and HARRISON, M.B. EDS. 1987. Plant nematology laboratory manual (in Spanish). Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

12.047 CRIS0088436

DETERMINATION AND USE OF ECONOMIC THRESHOLDS DENSITY OF SOILBORNE PATHOGENS

ABAWI G S; Plant Pathology; N Y Agricultural Expt Station, Geneva, **NEW YORK** 14456.
Proj. No.: NYG625487 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: Determine the relationship between initial inoculum densities of soilborne plantpathogens and disease incidence and crop yield. Assess and quantify the effect of biotic and abiotic parameters on economic threshold densities and population dynamics of soilborne pathogens. Develop and implemet integrated pest management programs for root diseases of major vegetable crops in New York State based on the concept of economic threshold densities.

Approach: Field microplot methodology will be used to determine the economic threshold densities of soilborne pathogens and the influence of selected biotic and abiotic factors on such densities. Populations dynamics of soilborne pathogens will be monitored using appropriate selective agar and/or natural host media. Disease incidence, disease severity, and yield parameters will be determined at preselected time intervals by destructive samplings. Tests will be also conducted under laboratory, greenhouse, root rot nursery, and commercial fields to generate needed data on the biology and ecology of soilborne pathogens. Integration of promising control measures (biological, cultural, and chemical) will be established and validated in field microplots, root rot nurseries, and commercial fields.

Progress: 82/10 to 88/09. Research conducted since 1982 has dealt with the biology and management of fungal and nematodal plant pathogens on snap bean, cabbage, table beets, lettuce, peas, tomatoes, and other crops. The occurrence of Rhizoctonia foliar blight of cabbage and Aphanomyces root rot of beans was demonstrated for the first time in New York. The relationships between initial inoculum densities of several pathogens (Fusarium, Rhizoctonia, Thielaviopsis, Pythium, and Pratylenchus) and disease incidence and growth parameters of beans was extensively studied in field microplots. The influence of initial densities of Heterodera schacttii on yield parameters of table beets and cabbage were also studied in field microplots. Field microplots were also utilized to study the effect of soil types, associated microflora, pesticides, and cover crops on damaging level and yield loss by several pathogens. Interactions among fungal and plant parasitic nematodes were studied on bean, tomato and soybean. Sources of resistance to charcoal rot, Fusarium wilt, Rhizoctonia hypocotyl and root rots, root-knot nematodes, and web blight have been identified among many accessions of beans through greenhouse and field testing. Extensive evaluation of fungicides and nematicides as seed and soil treatments was conducted resulting in a number of modification of the chemical control recommendations.

Publications: 82/10 to 88/09

PASTOR-CORRALES, M.A., and ABAWI, G.S. 1988. Reaction of selected bean accessions to infection by Macrophomina phaseolina. Plant Disease 72:39- 41.

PASTOR-CORRALES, M.A., and ABAWI, G.S. 1988. Bean accessions with resistance to Rhizoctonia solani under field conditions in Colombia. Turrialba 38:87-92.

DILLARD, H.R., and ABAWI, G.S. 1988. Occurrence of Aphanomyces euteiches f. sp. phaseoli on beans in New York State. Plant Disease 72:912.

ABAWI, G.S., and CROSIER, D.C. 1988. Field testing of fungicides as seed and soil treatments for the control of bean root rot, 1987. Fungicide and Nematicide Tests 43:104.

ABAWI, G.S., and CROSIER, D.C. 1988. Greenhouse evaluation of fungicides as seed and soil treatments for the control of root rot of table beets, 1987. Fungicide and

Nematicide Tests 43:106-107.

12.048 CRIS0130560
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

ABAWI G S; Plant Pathology; N Y Agricultural Expt Station, Geneva, **NEW YORK** 14456.
Proj. No.: NYG25492 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs. Determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships. Develop and validate predictive crop loss assessment systems. Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Considerable research will be conducted in field microplots, however, tests in commercial fields, nematode nurseries, greenhouses and growth chambers will be conducted as deemed necessary and appropriate. Nematological and pathological techniques will be used to monitor population dynamics of plant parasitic nematodes and associated soilborne microorganisms. Growth responses and yield parameters of host crops will be determined at preselected time intervals. A crop loss assessment system will be designed based on initial nematode density, crop cultivar, soil type, temperature regimes and others. Available biological, cultural and chemical control measures will be integrated into a nematode management program and validated in growers fields.

Progress: 88/01 to 88/12. Completed the study dealing with the relationship of initial population (Pi) density of Heterodera schachtii (Hs) on yield of cabbage as influenced by harvest time. Four Pi densities (0, 10, 20, and 40 eggs/cc soil) were established in each of 1986, 1987, and 1988 in field microplots with 10 replications/density/each of 3 harvest dates (75, 90, and 105 days after transplanting). Total and marketable weights were reduced proportionally by the Pi's of Hs and such losses were lower as harvest was delayed. But delaying harvest by up to 30 days did not result in complete recovery of infected plants especially at the highest Pi of Hs. In 1988, marketable yield of cabbage was reduced by 38, 40, and 68% at the first harvest and only 26, 20, and 43% at the second harvest with Pi densities of 10, 20, and 40 eggs/cc soil, respectively. Reaction of 16 bean lines to infection by two population of Meloidogyne incognita (Mi) and M. hapla (Mh) was determined under greenhouse conditions. Nemasnap, A211, G2587, G6278, G12727, BAT477 and RIZ30 were resistant to all populations tested. Eggs were produced on all plants, but their production on resistant lines was less than 7% of that on the susceptible Canario Divex, California Dark REd Kidney, A322, G3773 and G4450.

Publications: 88/01 to 88/12
ABAWI, G.S. and MAI, W.F. 1988. Effect of Heterodera schactii on maturity and yield of cabbage. Journal of Nematology 20:626 (Abstr.).
MULLIN, B.A., ABAWI, G.S., and KORNEGAY, J. 1988. Host suitability of bean germplasm to Meloidogyne incognita and M. hapla. Phytopathology 78:(in press, Abstr.).

12.049 0150248
DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

ABAWI G S; Plant Pathology; N Y Agricultural Expt Station, Geneva, **NEW YORK** 14456.
Proj. No.: NYG625496 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes; emphasizing biological and cultural control procedures. Evaluate these tactics and integrate effective procedures into practical nematode management programs which minimize crop losses, environmental contamination, and human health risks.

Approach: Nematological and pathological procedures will be used to identify soils suppressive to nematodes, isolate and evaluate the efficacy of parasitic and antagonistic organisms to nematodes, determine the interaction among nematodes and other soilborne organisms, identify vegetable crop germplasm with resistance to nematodes, and to assess the extent of yield losses caused by nematodes in principal vegetables. Developed biological and cultural control measures will be integrated into nematode management programs and evaluated. Tests will be conducted in the laboratory, greenhouse, field microplots and commercial production fields as deemed necessary.

12.050 CRIS0135399
BREEDING AND GENETIC INVESTIGATIONS OF RESISTANCE IN SWEET POTATOES TO THREE SOIL-BORNE DISEASES

COLLINS W W; Horticultural Science; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06069 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: To identify new sources of resistance to root-knot nematode (M. incognita), scurf (Monilochaetes infuscans) and soil rot (Streptomyces ipomoea) and incorporate that resistance into parental material for use in developing new cultivars.

Approach: New plant introductions and germplasm from other U.S. breeding programs will be evaluated for desired resistance. Several evaluation procedures will be used to determine the relative importance and independence of resistance in fibrous vs. storage roots. A genetic population will be established to determine heritability of resistance characters and thus select the proper breeding methods. Conventional breeding techniques will then be used to incorporate resistance into potential cultivars.

12.051* CRIS0070699
DAMAGE POTENTIAL AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03546 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Elucidate damage potential of nematodes, especially variable races of Meloidogyne incognita (MI) and M. Arenaria; determine impact of environment on related damage to tobacco and soybean; characterize spatial and temporal populations of nematode; develop and evaluate control tactics; monitor nematode communities species changes; and integrate information on MI on soybean into a simulator.

Approach: Field and microplot experiments will focus on "determinants" involved in nematode-induced crop losses. Evaluate utility of "nematode hazard indices" and economic thresholds. Incorporate data on soybean responses to MI into "CIPM" model. Study biochemical basis of differential virulence and resistance to Meloidogyne spp. on tobacco and mechanisms of nematode suppression of nodulation on soybean. Use findings to improve sampling procedures for advisory purposes. Direct cooperative research toward improving control tactics.

Progress: 87/01 to 87/12. Meloidogyne arenaria (MA) caused more severe damage to peanuts than M. hapla in an interaction study in microplots. Populations of MA differed in their virulence on tobacco. This species, M. hapla, and M. javanica had slight to no effect on the activity of M. incognita (MI) on resistant tobacco. Greenhouse evaluations showed a number of "USDA" tobacco lines to have resistance to one or more of these nematodes. These four root-knot species were found to have differential sensitivity to certain nematicides. Moisture levels affected MI-induced gall development on tobacco as well as leaf growth. Young plants and feeder roots of older Asparagus were found to be susceptible to this nematode. Older roots of this host apparently are resistant to MI. Sphaeronema sasseri and Pratylenchus macrostylus were widespread on Fraser fir and red spruce in the Black Mountains, NC. Both nematode species have low temperature optima.

Publications: 87/01 to 87/12

BARKER, K. R. 1987. Effects of irrigation and cultivar on growth and yield response of tobacco to aldicarb. J. Nematol. 19:511 (Abstr.).

BARKER, K. R., and NOE, J. P. 1987. Establishing and using threshold population levels. In Vistas on Nematology, p.75-81. Veech, J.A., and D.W. Dickson (eds.). Society of Nematologists. E. O. Painter Printing Co., FL.

BARKER, K. R., and NOE, J. P. 1987. Techniques in quantitative nematology, p. 223-236 In Experimental techniques in plant disease epidemiology. Kranz, J., and J. Rotem, eds. Springer-Verlag Berlin. Heidelberg-New York.

BARKER, K. R., STARR, J. L., and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.

CABANILLAS, H. E. 1987. Factors influencing the efficacy of Paecilomyces lilacinus in biocontrol of Meloidogyne incognita on tomato. Ph.D. Thesis, NCSU, Raleigh, N.C. 208 p.

KO, M. P. P.-Y, HUANG, J.-S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83: 229-305.

SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

12.052 0138711
ECOLOGY, PHYSIOLOGY, AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06099 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Develop and improve management tactics for Meloidogyne species and races; characterize the interactions of selected nematodes and their hosts as affected by the environment, especially soil texture, nutrients, moisture, and selected microflora; develop and refine models that characterize the dynamic interactions of Meloidogyne incognita on tobacco, and Heterodera glycines as affected by nematode levels and environment.

Approach: Experiments designed to fulfill the objectives shall be conducted in the greenhouse, laboratory, microplots, and in the field. Management tactics will emphasize cropping systems, biocontrol, resistance, and nematicides. Studies on environmental parameters will focus on their effects on nematode activity (reproduction, survival), and interactions with hosts. Host physiological processes under study include water utilization, photosynthesis, nitrogen metabolism, and mechanisms of resistance to nematodes. Major collaboration research components include those on resistance, nematicides, physiology, and modeling.

12.053* CRIS0088272
TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology. Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Ouchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09
RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.

RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

12.054* CRIS0132029
MORPHOLOGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDOGYNIDAE

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

12.055 CRIS0083047
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

RIEDEL R M; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000701 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Determine the relationships among nematode population densities and crop yields, and the impact of biotic and abiotic stress factors on these relationships.

Approach: Three hypotheses will be tested: Development of Early Dying Disease of Potato is a function of pre-plant populations of P. penetrans and V. dahliae as well as soil type, soil moisture and temperature; cultivars varying in resistance to V. dahliae will react differently to pre-plant populations of P. penetrans and V. dahliae; mixed populations of P. penetrans, P. crenatus and P. scribneri will interact with populations of V. dahliae differently than will monospecific populations. The study will be conducted in field microplots to which Verticillium microsclerotia (from cultures), and P. penetrans, P. crenatus and P. scribneri (from monoxenic culture) will be added in pre-determined numbers to fumigated soil. Pathogen-free potatoes from tissue culture will be planted in infested soil in

microplots. Symptom ratings will begin at the onset of symptom development and continue to harvest. Data on soil and root populations of nematodes and fresh weight of tubers will be taken.

Progress: 87/01 to 87/12. The interspecific competition of Pratylenchus penetrans and and P. scribneri is being studied in a field microplot system. Two years of field data indicate that indicate that P. scribneri reproduction in potato is reduced in the presence of low levels of P. penetrans. Pratylenchus spp. interactions may be useful in controlling development of multi-specific Pratylenchus communities in agronomic soils and designing crop rotation schemes for control of individual Pratylenchus species.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

12.056* CRIS0095114
BIOLOGY AND CONTROL OF ROOT AND FOLIAR PATHOGENS OF FIELD VEGETABLES

ROWE R C; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000795 Project Type: HATCH
Agency ID: CSRS Period: 02 JUN 88 to 28 FEB 91

Objectives: Evaluate fungicides for foliar disease control on vegetable crops; evaluate antagonistic microorganisms as biocontrol agents of root pathogens of vegetable crops; develop a disease forecasting system for gummy stem blight of greenhouse cucumber & implement practical control procedures; and study the etiology of potato early dying disease with respect to the influence of species of Pratylenchus, fertility, soil moisture and host resistance on the interaction of root-lesion nematodes and Verticillium dahliae; determine the existence of pathotypes in populations of V. dahliae; and develop an improved disease forecasting system.

Approach: Annual field trials of fungicides; isolation of biocontrol agents from root rhizospheres followed by greenhouse and field tests to evaluate efficacy and application techniques; evaluation of temperature and leaf wetness effects on infection of cucumber by D. bryoniae using controlled incubation facilities and development of mathematical disease forecasting model; use of field microplots to evaluate effects of species of Pratylenchus, fertility, soil moisture and host resistance in potato early dying syndrome.

Progress: 87/01 to 87/12. Five rates of Talaromyces flavus and three of Verticillium dahliae were again used in a factorial field microplot study to test Tf as a disease biocontrol agent on potato. Preliminary analysis indicated that no Tf treatment affected disease development or yield. Similar greenhouse studies were conducted to confirm field findings. Isolates of V. dahliae were assigned to vegetative compatibility groups based on pairings of mutants unable to use nitrate. Nine isolates belonged to VCG 3 and ten to VCG 4. Pathogenicity studies indicated that those in VCG 4 are more virulent than those in VCG 3. A survey of 108 radish plantings was conducted to obtain data on effects of environmental and cultural variables on development of Rhizoctonia stem canker. Correlations were found between disease incidence and soil moisture, air temperature, previous crop and radish cultivar. Studies are underway to evaluate relationships of inoculum density and nutrient status of the fungus with disease development. In studies conducted to investigate the etiology of Fusarium crown and root rot of tomato in rockwool culture, we found that the ability of the fungus to colonize this substrate is limited and that control efforts should be aimed at the production of disease-free transplants. Studies were initiated to investigate environmental effects on development of Didymella bryoniae on cucumber. Spore germination optima were 20-24 C.

Publications: 87/01 to 87/12
ROWE, R.C., DAVIS, J.R., POWELSON, M.L., and ROUSE, D.I. 1987. Potato early dying: Casual agents and management strategies. Plant Dis. 71:482-489.

12.057* CRIS0094508
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

BLOOM J R; JAFFEE B A; Plant Pathology; Pennsylvania State University, University Park, **PENNSYLVANIA** 16802.
Proj. No.: PEN02769 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs; determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships; using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Cooperate in the sampling and extraction research, emphasizing the precision of population recovery in relation to nematode temporal dynamics and life cycle stages, in relation to apple and peach production. Determine influence of Xiphinema spp. and Hoplolaimus spp. on growth and cold hardiness of peach trees. Determine role of orchard ground cover management systems on Xiphenema spp.

Progress: 87/01 to 87/12. Variable population levels of 'Xiphenema' 'americanum' were maintained under "Redskin" peach trees planted in 1984 in plots where dandelion numbers varied per tree. The relationship of nematode and dandelion populations to the incidence of Prunus stem pitting disease was established. No incidence of stem pitting was observed to date, indicating either an insufficient number of nematodes or dandelions was maintained for virus spread to occur or

that insufficient time had elapsed to adequately assess the results. In a separate experiment, "Sunhigh" peach trees propagated from the mild strain of Prunus necrotic ring-spot (PNRSV) continued to produce no obvious symptoms by the summer of 1987. NRSV-infected "Sunhigh" trees propagated with the severe ringspot virus strain continued to show "shock" symptoms during the summer of 1987. These infected trees showed no dieback, canker development, or reduced tree trunk growth related to virus infection.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

12.058 CRIS0097277
IMPROVEMENT OF VEGETABLE PRODUCTION THROUGH INTEGRATED NEMATODE MANAGEMENT

ACOSTA N; VICENTE N; LUGO M L; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTO RICO** 00928. Proj. No.: PR-2-2663Project Type: SPECIAL GRANT Agency ID: CSRS Period: 15 JUL 85 to 31 JUL 88

Objectives: To determine effects of P. lilacinus, L. leucocephala and M. deeringiana on the pop. dynamics of M. incognita, M. javanica, R. reniformis, and Pratylenchus spp. and on tomato, pepper, and pigeonpea yields; to evaluate the suitability of tomato and pigeonpea lines to pops. of M. incognita, M. javanica, and R. reniformis; to evaluate the effect of integrating cropping-sequence systems, biol. control, and resistant cultivars on yields of pigeonpea, tomato, pepper, and pumpkin.

Approach: Replicated field treats. using tomato, pepper, and pigeonpea will be set up to test Paecilomices, Leucaena, and Mucuna as nematode control agents. Paecilomyces will be added to infested soil a week before or at planting. Leucaena and Mucuna will be planted in heavily infested soil. Sixty days later they will be pulled out and tomato, pigeonpea, pepper, and coffee will be planted in the soil infested with M. incognita, M. javanica, R. reniformis and Pratylenchus, respectively. Cropping sequences will be set up using Mucuna, Leucaena, resistant and susceptible tomatoes, and pigeonpeas. Crops grown in the 2nd. sequence will follow each of the crops grown in the 1st. Pigeonpea lines from P.R. and India will be tested for resistance to M. incognita.

Progress: 85/07 to 88/07. At the end of the third year of a Mucuna-tomato-pigeonpea rotation it was demonstrated that Mucuna is highly resistant to M. incognita and R. reniformis populations. Leucaena leucocephala, even though effective in reducing nematode populations in the soil, is difficult to handle. Therefore, its use in rotations is not encouraged. Higher yields of a root-knot susceptible tomato "Flora Dade" and froma reniform-susceptible pigeonpea were obtained with Mucuna rotation. A rotation sequence of tomato-Mucuna-tomato is strongly recommended. Significantly less Meloidogyne eggs were collected from roots of tomato plants watered with Mucuna root exudates. Mucuna and Leucaena are not as effective in reducing Pratylenchus and Tylenchorhynchus populations in the soil. The nematophilic fungus Paecilomyces lilacinus is a promising good control for Meloidogyne in tomato grown in soils with a high organic matter content. The fungus works better when added to infested fields at planting or 2 weeks before or after planting. The fungus grows better in commercial polished rice than in other rice substrates. Promising tomato and pigeonpea genotypes highly resistant to Meloidogyne were identified. The fungus Arthrobotrys combined with Paecilomyces reduces root-gall formation in susceptible tomato. Fifteen mililitiers of a mycelial suspension of Arthrobotrys added to the seedbed, 30 days prior to nematode inoculation and transplanting reduced rootgall formation, number and size and number of larvae in infected roots.

Publications: 85/07 to 88/07
LUGO, M., VICENTE, N. and ACOSTA, N. 1988. Evaluacion de variedades de tomate (Lycopersicon esculentum Mill.). para susceptibilidad al nematodo nodulador M. incognita. J. Agri. Univ. P.R., October 1988 (in press).
VICENTE, N., ACOSTA, N. and SCHRODER, E.C. 1986. Reaction of Leucaena Leucocephala to populations of Meloigodyne incognita and M. javanica from Puerto Rico. J. Agri. Univ. P.R. 70(2): 157-58.
VICENTE, N., ACOSTA, N. and SANCHEZ, L. 1989. Efecto de sustratos de arroz (Oriza sativa L.) en el crecimiento del hongo biocontrolador de nematodos Paecilomyces lilacinus. J. Agri. Univ. P.R. January 1989 (Accept. for pub.).

12.059 CRIS0135799
IMPROVEMENT OF VEGETABLE CROPS PRODUCTION LEVELS THROUGH INTEGRATED NEMATODE CONTROL MANAGEMENT

ACOSTA-VILLEGAS N; VICENTE N; ROMAN O; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTO RICO** 00927. Proj. No.: PR-3611 Project Type: SPECIAL GRANT Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 89

Objectives: Determine the effect of Mucuna deeringiana, corn, the nematophilic fungi Arthrobotrys and Curvularia and the bacteria Pasteuria penetrans on the population dynamics of Meloidogyne incognita and Rotylenchulus reniformis, and on yields of tomato and pigeonpea. To evaluate the suitability of promising tomato, and pigeonpea cultivars and advanced lines to populations of M. incognita and Rotylenchulus reniformis in the field and the effect of integrating cropping-sequence systems, biological control, resistant cultivars and nematicide applications on tomato yield.

Approach: The effect of Mucuna deeringiana and corn on population dynamics of M. incognita and R. reniformis will be determined in two field experiments using cropping sequence system rotations with tomato and pigeonpea as main crops. Each sequence will consist of two

croppings. Nematode populations will be recorded prior to planting, 5 weeks after, and at harvest. Fifty-four pigeonpea genotypes will be evaluated for resistance to populations of M. incognita in seedbeds containing a sandy loam soil mixture heavily infested with Meloidogyne. Data on nematode eggs and root-gall index will be recorded 55 days after planting.

12.060* CRIS0057100
EVALUATION OF NEMATODE CONTROL PRACTICES IN CROPS OF ECONOMIC IMPORTANCE

DRAMAS D; ACDSTA N; RDMAN J; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTO RICO** 00927.
Proj. No.: PR00247 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 28 FEB 93

Objectives: To evaluate nematicides, alone and concurrently with cultural, physical and biological selected control practices potentially effective for the control of nematodes affecting crops of economic importance in Puerto Rico.

Approach: Preliminary greenhouse tests will be conducted to select effective nematicides and rates and to evaluate, whenever necessary, selected control practices. The most promising treatments will be tested in the field to determine effects on yield and quality, residue levels and phytotoxicity. Field evaluation will be conducted at different sites and will include nematicide treatments alone and concurrently with cultural, physical and biological selected control practices. The evaluation criteria will be nematode population before, after treatments and at harvesting; commodity yield and quality; cost and earning of the treatments; residues in commodities; persistance in the soil; hazard to humans and toxicity to mammals and plants.

Progress: 87/01 to 87/12. Liquid formulations of fenamiphos, carbofuran and fensulfothion were applied alone and in combination with their granular counterparts (butylfos and carbofuran) as soil treatments in yams. Temik 10G as standard and oxamyl 24L as a check were used for comparison. The trial is underway and data are not available yet. A field experiment was conducted to determine the efficacy of terrazole, thiabendazole and aldicarb, alone and in combinations on the control of fungi and nematodes in plantains. They were not effective against root rot. Significant yeild differences over the control were obtained in nematicide-treated plots, regardless of fungicide treatment. Fruit weight was significantly higher in watermelon plots treated with Paecilomyces lilacinus fungus 2 weeks before planting and in carbofuran-treated plots ad compared to control ones. Significant differences in yield over the control were obtained with applications of carbofuran at 2.24 and 4.48 kg/ha. Three cucumber varieties were evaluated as to root knot nematode resistance at the Isabela Substation. There were no significant differences in yields between cultivars Dasher II and Poinsett 76, but the first one was significantly most resistant than cultivar Geminis 7. Eighteen pumpkin lines were evaluated in the greenhouse as to resistance to M. incognita but only DR-14 and DR-11 were moderately resistant. A survey of 25 commercial farms showed that R. reniformis was the most common nematode associated with papaya.

Publications: 87/01 to 87/12

ECHAVEZ-BADEL, R. 1987. Evaluacion preliminar de la resistencia del pepinillo al nematodo nodulador. Memorias Sociedad Puertorriquena de Ciecias Agricolas, Gurabo, P.R., Nov. 13, p. 21 (Abstr.).

NEGRON, J. and ACDSTA, N. 1987. Studies on host-parasite relationships of Meloidogyne incognita and Coffea arabica cv. Borbon. Nematropica 17(1):71-78.

DRAMAS, D. and RDMAN, J. 1987. Cambios histologicos inducidos en la raiz del platano (Musa acuminata x M. balbisiana, AAB) por 4 especies de nematodos de importancia economica en Puerto Rico.

VICENTE, N., ABREU, E. and MEDINA-GAUD, S. 1987. Chemical control of Meloidogyne incognita, Rotylenchulus reniformis and Anthonomus eugenii in Capsicum annuum and C. frutescens. Nematropica 17(2):163-69.

12.061 CRIS0141043
INSECT PESTS OF VEGETABLES IN THE SOUTHERN REGION

ELSEY K D; SCHALK J M; Agricultural Research Service, Charleston, **SOUTH CAROLINA** 29407.
Proj. No.: 6659-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 31 MAR 89

Objectives: Develop better pest management of insect pests of sweet potatoes, cucurbits, and southern peas through improved plant resistance and implementation of new technologies for insect population suppression.

Approach: Evaluate sweet potato lines by mass selection for resistance to soil pests. Bioassay periderm extracts for antibiosis to Diabrotica. Investigate factors involved in attractancy of cucurbits to pickleworm moths by bioassay of chemical components of squash foliage. Test pickleworm sex pheromone for efficacy and longevity in the field. Study influence of environmental factors on seasonal phenology and determine reproductivity. Study migrating behavior of 4 entomophagous nematodes indigenous in soil and persistence of infective stages, through time.

Progress: 87/01 to 87/12. Pickleworm moths were caught in sex pheromone traps two weeks before pickleworm larvae were found on foliage. Further development of this technique will provide a valuable pest management tool for giving growers advance warning of larval infestations. A culture of the nematode parasite of cucumber beetles, Filipjevimeris leipsandra, was reestablished and work was begun on establishing temperature development

curves for the various stages. Spotted cucumber beetle adults were found to be more resistant to subfreezing temperatures than adults of the banded cucumber beetle. Regional trials were conducted for identifying insect resistant sweet potatoes. One entry (Excel) was identified as having high levels of resistance to 10 soil insects. Population dynamics of sweet potato soil insects in resistant and susceptible plantings are in progress. A diet for the banded cucumber (BCB) larvae was developed which provided a 58% weight gain and 96% survival after 3 days exposure to the media. A sex pheromone for the BCB was field tested. Male BCB prefer to mate during the night, the greatest frequency occurs within a few hours after darkness. Longevity testing of the pheromone is still in progress. A total of 83 bacterial isolates were identified from the abdomen of the BCB.

Publications: 87/01 to 87/12

PENA, J.E., WADDILL, V.H., and ELSEY, K.D. 1987. Population Dynamics of the pickleworm and the melonworm in Florida. Environ. Entomol. 16:1057-1061.

PENA, J.E., WADDILL, V.H., and ELSEY, K.D. 1987. Survey of native parasites of the native pickleworm and the melonworm in southern and central Florida. Environ. Entomol. 16:1062-1066.

SCHALK, J.M., PETERSON, J.K., and HAMALLE, R.J. The abdominal flora of the banded cucumber beetle, Diabrotica balteata Le Cont. J. Agricultural Entomol. (Accepted 11/11/87).

12.062 CRIS0141229
PRODUCTION EFFICIENCY OF VEGETABLE CROPS THROUGH NEMATODE AND DISEASE RESISTANCE

FASSULIOTIS G; Agricultural Research Service, Charleston, **SOUTH CAROLINA** 29407.
Proj. No.: 6659-22240-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 11 MAR 86 to 10 MAR 91

Objectives: To enhance vegetable germplasm with resistance to nematodes and other diseases through transfer of resistance factors by embryo culture, somatic hybridization, somatic embryogenesis, DNA injection and somaclonal variation.

Approach: Evaluate species of Cucumis, Solanum, and Brassica for resistance to root knot nematodes and other diseases. Transfer resistance factors through embryo culture, somatic embryogenesis, protoplast fusion or direct DNA transfer into ovaries. Study the mechanism of resistance in parents and hybrids histologically and with atomic absorption spectrophotometry.

Progress: 87/01 to 87/12. F1 hybrid plants obtained through somatic embryogenesis from the cross C. metuliferus (line 3503) x C. anguria (PI233646) were self compatible at a low frequency. Of 16 fruit obtained from 93 pollinations, seven embryos were recovered from a single fruit from which two F2 plants were grown bearing flowers. Reproduction of the southern root-knot nematode, Meloidogyne incognita on F1 and F4 hybrid plants was intermediate to both parents. The F1 and F4 backcrosses to C. metuliferus 3503 and line 701A expressed greater resistance to M. incognita than the F1 hybrids. Crosses of the hybrid with C. melo produced abortive embryos which could not be converted to whole plants. A collection of 24 PIs of C. metuliferus indicated wide variability in response to M. incognita infection. Isozyme analysis of leaf extracts indicated no correlation of esterase bands with nematode resistance. Eggs of M. incognita encapsulated in a water soluble hydrogel, carrageenan, retained viability and infectivity for two years when stored at 15C.

Publications: 87/01 to 87/12

FASSULIOTIS, G. and B.V. NELSON. Interspecific hybrids of Cucumis metuliferus x C. anguria obtained through embryo culture and somatic embryogenesis. Euphytica 36(3). (Accepted 03/13/87).

FASSULIOTIS, G. 1987. Genetic basis of plant resistance to nematodes. In: Vistas on nematology (J.A. Veech and D.W. Dickson, eds.) pp 364-371. Soc. of Nematologists.

12.063 CRIS0142059
GERMPLASM ENHANCEMENT OF VEGETABLE CROPS THROUGH BREEDING AND BIOTECHNOLOGICAL MEANS

FASSULIOTIS G; THOMAS C E; DUKES P D; Agricultural Research Service, Charleston, **SOUTH CAROLINA** 29407.
Proj. No.: 6659-21000-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 FEB 87 to 01 AUG 87

Objectives: To select genes in breeding lines, primitive cultivars or wild species of individual vegetable crops that have high potential to the U. S. vegetable industry. To incorporate these genes into enhanced vegetable germplasm andrelease this germplasm to public and private plant breeders.

Approach: Conventional breeding techniques will be used to incorporate genes conferring heat tolerance, cold soil tolerance and soil-borne disease resistance into snap beans. New breeding methodologies for muskmelons willbe used to transfer aphid or downy and powdery mildew and root-knot nematode resistances into acceptable types. Biotechnology techniques will be used to generate somaclonal variants and haploids of broccoli germplasm for increased genetic resistance to downy mildew or black rot diseases and horticultural acceptability. Resultant plant materials will be evaluated in laboratory, greenhouse and field to determine whether they exhibit the selected genetic characters and other traits useful to plant breeders.

Progress: 87/01 to 87/12. To incorporate pathotype non-specific resistance to downy mildew (Pseudoperonospora cubensis) from muskmelon (Cucumis melo) breeding line MR-1 into a genotype with horticulturally acceptable fruit quality, a backcrossing program utilizing MR-1 and Mainstream was begun. Downy mildew

reaction types (RT) and fruit quality were used to make selections from F3 fruit-to-row populations of MR-1 x Mainstream. Progeny of selections were evaluated for RT through artificial inoculations in the greenhouse and selections were made for backcrossing to each parent. Candidate sources of high levels of downy mildew (Peronospora parasitica) resistance were found in broccoli (Brassica oleracea var italica) and cauliflower (B. oleracea var botrytis) genotypes from the USPI and Wellesbourne, England collections through artificial inoculations in growth chambers and field plots. Cell lines were established from commercial broccoli cvs. and plants were regenerated from these cell lines to examine tissue culture induced variation to downy mildew. From approximately 2000 anthers representing 8 commercial broccoli cvs. and 2 rapid cycling Brassica populations, embryo induction was achieved in 3 cvs. Approximately 50 anther-derived plants were regenerated. Variation was noted in both chromosome number and plant color.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

12.064 CRIS0142056
EVALUATION OF VEGETABLE GERMPLASM FOR HORTICULTURAL AND GENETIC CHARACTERISTICS

FERY R L; Agricultural Research Service, Charleston, **SOUTH CAROLINA** 29407.
Proj. No.: 6659-21000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 FEB 87 to 31 JUL 87

Objectives: To evaluate existing or recently introduced vegetable germplasm for important horticultural and genetic characteristics for development of GRIN database.

Approach: Collections of vegetable germplasm will be evaluated for horticultural characteristics and selected disease, nematode and insect resistances using standardized methods. Contracts will be issued to selected state agricultural experiment stations and ARS laboratories with the required expertise to evaluate this germplasm based on specific criteria developed by appropriate Crop Advisory Committees. Data retrieved from these evaluations will be entered into GRIN for utilization by public and private breeders.

Progress: 87/01 to 87/12. All available Plant Introductions (P.I.'s) of onion and related species were evaluated at Madison, WI, for resistance to pink root and Fusarium basal rot. Two onion P.I.'s exhibited a high level of resistance to pink root and 63 were segregating for resistance. Two P.I.'s were resistant to Fusarium basal rot whereas 118 segregated for resistance. Allium pskemense, A. fistulosum, and A. altaicum P.I.'s were generally resistant to both pink root and Fusarium basal rot. Work was initiated at Salinas, CA, to identify lettuce lines resistant to premature seed stalk elongation (bolting); two growth chambers were purchased for evaluation of germplasm under varying light and temperature conditions. Evaluations for resistance against downy mildew were conducted at Charleston, SC, on 212 P.I.'s classified as Brassica oleracea var. botrytis. None of the P.I.'s exhibited a high level of resistance. Moderate levels of resistance were found in P.I.'s 181860, 204765, 204768, 204772, 204773, 204775, 204779, 241612, 291567, 343481, and 462225. Studies have been initiated at Charleston, SC to evaluate southernpeas and peppers for resistance to the peanut root-knot nematode (Meloidogyne arenaria), peppers for tolerance to the herbicide glyphosate, and southernpeas for tolerance to the herbicide bentazon.

Publications: 87/01 to 87/12
THOMAS, C.E. and JOUROAIN, E.L. Evaluation of Brassica oleracea var. botrytis plant introductions for resistance to downy mildew. Crucifer Genetics Workshop IV. Crucifer Genetics Cooperative, Madison, WI. (Accepted 10/11/87). (Abstract).

12.065 CRIS0141454
GENETICS AND GERMPLASM ENHANCEMENT OF LEGUMINOUS AND SOLANACEOUS VEGETABLE CROPS

FERY R L; OUKES P D; Agricultural Research Service, Charleston, **SOUTH CAROLINA** 29407.
Proj. No.: 6659-22000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 31 MAR 91

Objectives: Oevelop the germplasm and methodology needed to breed improved leguminous and solanaceous vegetable germplasm lines and cultivars that can resist theadverse effects of diseases, nematodes, and insects. To develop the germplasm and methodology needed to breed herbicide tolerant vegetable germlasm lines and cultivars.

Approach: Research will encompass 3 phases: 1) plant introductions to locate needed or better sources of pest resistances and herbicide tolerance, 2) genetic studies will be conducted to determine the inheritance of the resistance ortolerance factors, and 3) breeding programs will be developed to transfer the newly identified resistance/tolerance genes into commercial-type germplasm. This basic approach will be supplemented by concurrent research projects to determine the nature and value of resistances and to develop orrefine evaluation procedures, selection criteria, and plant breeding methodologies. Crops included are southernpea, snap bean, and pepper.

Progress: 87/01 to 87/12. 'Kiawah' southernpea was released as a replacement for 'Pinkeye Purple Hull', a widely grown commercial cultivar. The major attribute of 'Kiawah' is its high level of resistance to root knot, a major root disease of southernpea incited by several species of the root-knot nematode genus Meloidogyne. The southernpea breeding lines US-311 and US-427 were released for use as parental materials in breeding programs. US-311 is an early maturing, pinkeye type pea and US-427 is a root-knot resistant, brown crowder type pea. The evaluation phases of studies to determine the inheritance of

southern blight (Sclerotium rolfsii) resistances exhibited by two southernpea accessions ('Carolina Cream' and CR-61N) were completed. The evaluation phases of several studies to determine the inheritance of various levels of resistance in peppers to root-knot nematodes were completed. Efforts to breed horticulturally superior bell pepper germplasm with resistances to root-knot nematodes and southern blight and tolerances to the herbicide bentazon were continued. The wild tomato Lycopersicon hirsutum f. glabratum PI 134417 was found to possess factors associated with the foliar lamellae which cause extensive mortality to late instar larvae and pupae of the Colorado potato beetle (Leptinotarsa decemlineata); the genetic system conditioning the lamellae-based resistance is distinct from the system conditioning the glandular trichome/2-tridecanone mediated resistance studied earlier.

Publications: 87/01 to 87/12

FERY, R.L. and KENNEDY, G.G. 1987. Genetic analysis of 2-tridecanone concentration, leaf trichome characteristics, and tobacco hornworm resistance in tomato. J. Amer. Soc. Hort. Sci. 112(5):886-891.

FERY, R.L. and DUKES, P.D. US-311 and US-427 southernpea breeding lines. HortScience. (Accepted 12/23/87).

FERY R.L. and DUKES, P.D. 1987. Notice of release of Kiawah, a root-knot nematode resistant pinkeye type southernpea. USDA, ARS, Washington, D.C. July 8, 1987.

FERY, R.L. and DUKES, P.D. 1987. Notice of release to plant breeders of US-311 and US-427 southernpea breeding lines. USDA, ARS, Washington, D.C. July 13, 1987.

12.066 0138475

INFLUENCES OF MULCHES ON NEMATODES AND DISEASES IN TOMATO AND CORN

FORTNUM B A; Plant Pathology & Physiology; Pee Dee Res & Educ Center, Florence, **SOUTH CAROLINA** 29501.

Proj. No.: SC01323 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 89 to 30 JUN 94

Objectives: Colored plastic mulches, chosen for the quality of light (far-red to red ratio relative to direct sunlight) reflected from their surface, will be evaluated for their effect on root-knot of tomato. Organic mulches and corn hybrids will be assessed for their effect on phytoparasitic nematodes and diseases of corn.

Approach: Colored plastic mulches will be evaluated under field and greenhouse conditions for their effects on root-knot of tomato. Field evaluation will assess plant biomass accumulation, photosynthesis rates, stomatal conductance, and yield. Greenhouse studies will be conducted in simulated planting beds where soil moisture and temperature can be controlled. The effect of organic mulches (corn stover, grain, and legume cover crops) and corn hybrids on phytoparasitic nematodes will be evaluated. In studies utilizing corn stover as the organic mulch the stover will be either left on the soil surface, incorporated with tillage or mechanically removed without soil disturbance. In studies involving grain or legume cover crops the mulches will be incorporated with tillage prior to planting the corn crop.

Progress: 89/07 to 89/12. Colored plastic mulches altered tomato growth under field conditions and impacted losses to root-knot nematodes. Tomato plants grown over white mulch were larger and had more fruit than tomato plants grown over black mulch. Tomato plants grown over white mulch and innoculated with 100,000 Meloidogyne incognita eggs were as large and had as high a yield as tomato plants grown over black mulch without nematodes. The effect of mulch color on nematode development is under study.

Publications: 89/07 to 89/12

NO PUBLICATIONS REPORTED THIS PERIOD.

12.067 CRIS0091504

DISTRIBUTION AND ECOLOGY OF PHYTOPARASITIC NEMATODES IN TENNESSEE

BERNARD E C; Agricultural Exper. Station; University of Tennessee, Knoxville, **TENNESSEE** 37996.

Proj. No.: TEN00719 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To map the distribution of nematodes in Tennessee, and to elucidate factors responsible for those distributions. To study the interactions of nematodes with their hosts and local environments.

Approach: Collection and identification of nematodes will be made from poorly collected areas of the state and from special vegetation and crop types. The known locations of species will be mapped and compared with topographical, soil, and vegetation maps for elucidation of distribution-limiting factors. Factors responsible for nematode density fluctuations will be studied. Such factors include effect of host absence and climate outside of the growing season, effects of soil fungi and various faunal components, and tillage and double-cropping systems. General environmental effects will be determined by the monitoring of nematode populations throughout two or more growing seasons; the results will be useful in determining the proper times for sampling, and for predicting probable densities in the following growing season. Densities of soil fungi antagonistic to nematodes will be established by a modification of the most-probable-number method.

Progress: 87/01 to 87/12. A survey of plant-parasitic nematodes in virgin areas of the Great Smoky Mountains Natinal Park was continued. An undescribed root-knot nematode (Meloidogyne sp.) was found on hemlock. Perineal patterns of the females are highly reminiscent of M. graminis. Juveniles are large and stocky with a stylet length averaging 16 um. Another nematode was collected with characters similar to Nagelus and Merlinius,

but not fitting well into any genus. The nematode fauna of the park's virgin areas is almost completely different from that in agricultural and other disturbed areas. A study was begun on the importance of soil fungi in the regulation of Meloidogyne incognita in commercial tomato fields in east tennessee. Females removed from roots were surface-infested with fungi, mostly Paecilomyces lilacinus, but were rarely infected. Similarly, eggs within egg masses were not parasitized. However, when eggs were embedded in agar on microscope slides and buried for one week, parasitism rates were 15-30%. Females and eggs within egg masses appear to be well-protected from antagonistic fungi, and probably are poor targets for biological control tactics.

Publications: 87/01 to 87/12

BERNARD, E.C. and WITTE, W.T. 1987. Parasitism of woody ornamentals by Meloidogyne hapla. Ann. Appl. Nematol. 1:41-45.

12.068 CRIS0099615

LIFE TABLE STUDIES OF ROOT-KNOT AND CYST NEMATODES

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00822 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 86 to 31 AUG 88

Objectives: To develop basic life tables for root-knot (Meloidogyne spp.) and soybean cyst (Heterodera glycines) nematodes.

Approach: Experiments will be conducted in the greenhouse and in growth chambers to determine stage survival rates, life tables, and fertility tables. Stage survival rates will be calculated according to Ruesink's method. Nematode survivorship will be determined for critical life events: hatch, penetration, establishment, maturity, reproduction. The effects on survivorship of nematode source, plant host, initial nematode density, soil type, and temperature will be determined. Three geographically widely separted isolates of M. incognita and N. glycines will be obtained. Each isolate will be tested on three different hosts. Inoculation and infestation techniques will be compared. Each nematode x host combination will be established in sand, loam, or clay loam. Root systems will be harvested at intervals and assayed for nematode life stages. Sex ratios and natural female nortalities will be determined.

Progress: 87/01 to 87/12. The growth and maturation dynamics of Meloidogyne incognita on different plants were studied in containers. Soil within each container was infested with 1,000 eggs and planted with a squash, sunflower, or soybean seedling. Six, 12, 18, 24 and 30 days later, roots were harvested from each set of plants and stained. Nematodes were categorized as non-swollen juveniles, sausage-stage juveniles, and females. Moost of the juveniles entering roots did so within the first six days, but fewer entered sunflower than soybean and squash. Established, swollen juveniles were most abundant at 12 days on squash and sunflower, but at 18 days on soybean. Most of the juveniles on squash and sunflower had matured to females at 18 days, but on soybean had failed to do so in large numbers until 30 days after planting. Soil counts on non-penetrating juveniles were negligible 18 days after planning. Similar experiments are now being conducted with different initial densities, soil types, and nematode isolates to determine their effects on nematode life histories.

Publications: 87/01 to 87/12

ND PUBLICATIONS REPORTED THIS PERIDD.

12.069 CRIS0049138

ASSESS AND QUANTIFY PLANT-PEST INTERACTIONS TO DEVELOP SUBROUTINES FOR VEGETABLE PRODUCTION MODELS

HEALD C M; ROBINSDN A F; USDA-ARS Subtropical Res Lab Dklahoma - Texas Area; Agricultural Research Service, Weslaco, **TEXAS** 78596.
Proj. No.: 6204-24610-001-00D
Project Type: INHDUSE
Agency ID: ARS Period: 24 APR 84 to 24 APR 89

Objectives: Determine interactions among plant growth and developmental processes, nematodes, pathogens, weeds and insects. Integrate data into plant-pest subroutines to be used, ultimately, in generalized models for vegetable crop production that can be used by farmers for making management decisions.

Approach: Systems analysis will be used to identify research disciplines and information needed to develop an integrated pest-vegetable cropping model. Plant-pest subroutines will include mechanisms controlling plant senescence, effects of nematodes on plant physiology and biochemistry, motility and survival of nematodes as affected by water regulation, nutrients and plant growth regulators responsible for latent fungal infections in muskmelons, field bioassays to measure contributions of plant parts and to develop threshold concentration for allelochemical responses, and leafminer simulations to evaluate significant plant production responses. Research results will be used to develop and integrate the subroutines..

Progress: 87/01 to 87/12. Compared to standard placement (25 cm) of fumigant nematicide, deep placement (50 cm) resulted in a significant increase in cantaloup production. Analysis of the soil profile for nematode mortality in treated soil revealed that a wider pattern of nematode mortality occurred when the chemical was placed deep. Results of nematicide treatments on roses were also reported. Chemical attractants of DRRINA PHYLLDBIA were extracted from host tissues, partially purified by HPLC and chemically characterized. Effects of thermal adaptation on nematode behavioral responses to temperature were reported for two foliar and two root parasitic nematodes. Computer methods were used to superimpose the

locations of nematode samples from 1500 fields and orchards of the Lower Rio Grande Valley onto soil classification maps. Analysis of nematode sampling data from fields and orchards at the Rio Grande Valley revealed that the distributions of the two major nematode pests are differentially congruent with soil texture patterns within the region. This indicated that important, but unknown, ecological factors limit the distributions of MELOIOOGYNE INCOGNITA and ROTYLENCHULUS RENIFORMIS differently. The relationship between carbon partitioning and activities of sucrose metabolizing enzymes was examined in soybeans infected with the root-knot nematodes M. INCOGNITA. Nematode infection did not significantly affect the activity of invertase or sucrose synthase in roots or immature leaves.

Publications: 87/01 to 87/12

HEALO, C.M. and MEREDITH, J.A. 1987. Response of three tobacco cultivars to three ROTYLENCHULUS RENIFORMIS populations. Nematropica 17:95-98.

HEALO, C.M. and STEIN, E. 1987. Effect of ROTYLENCHULUS RENIFORMIS on yield and oil quality of sunflowers. Nematropica 17:1-5.

HEALO, C.M. and ROBINSON, A.F. 1987. Effects of soil solarization on ROTYLENCHULUS RENIFORMIS in the Lower Rio Grande Valley of Texas. J. Nematol. 19:93-103.

ROBINSON, A.F., HEALO, C.M.,... THAMES, W.H. and AMAOOR, J. 1987. Geographical distributions of ROTYLENCHULUS RENIFORMIS, MELOIOOGYNE INCOGNITA and TYLENCHULUS SEMIPENETRANS...related to soil texture/land use. Ann. Appl. Nematol. 1:20-25.

HEALO, C.M. and O'BANNON, J.H. 1987. Citrus declines caused by nematodes vs. slow decline. Triology 26:4 pp.

ROBINSON, A.F., HEALO, C.M. and FLANAGAN, S.L. 1987. Relationships ...texture... distributions of ROTYLENCHULUS RENIFORMIS, MELOIOOGYNE INCOGNITA and TYLENCHULUS SEMIPENETRANS in the Lower Rio Grande Valley. J. Nematol. 19:553.

HEALO, C.M., BRUTON, B.O. and OAVIS, R.M. 1987. The influence of GLOMUS INTRARAOICES, MELOIOOGYNE INCOGNITA and soil phosphorus levels on CUCUMIS MELO. J. Nematol. 19:528.

12.070 CRISO142579

VALIDATION OF WEED AND PESTICIDE MODELS IN IRRIGATED CROPS

GRIFFIN G O; Agricultural Research Service; Agricultural Research Service, Logan, **UTAH** 84322.

Proj. No.: 0500-21010-002-330 Project Type: INHOUSE

Agency IO: ARS Period: 01 OCT 85 to 30 SEP 88

Objectives: Oetermine the effect that various regimes of weed control by herbicides have on crop nematodes in continious corn production. Four species of nematode populations will be monitored. Some herbicides may suppress nematodes by direct effect or by eliminating weed hosts. Others may enhancecertain species by altering soil ecology.

Approach: Standardized soil samples will be taken several times during the season from each of the various treatment plots. Total and relative amounts of each species of nematodes will be determined. Larval stages and physiological condition will also be noted as well as level of damage to the host crop.

Progress: 87/01 to 87/12. Oata, similar to that obtained in 1986, showed that corn was a nonhost for the endoparasitic sugarbeet cyst nematode, Heterodera schachtii. There was approximately a 50% decline in the soil nematode population under corn culture. However, corn was a fair to good host for the ectoparasitic American dagger nematode, Xiphinema americanum, the ectoparasitic stunt nematode, Merlinius brevidens. The ectoparasitic spiral nematode, Helicotylenchus crenacauda, and the migratory endoparasitic root lesion nematode, Pratylenchus neglectus. The reproductive index (R), final population/initial population, of P. neglectus, H. crenacauda, M. brevidens, and X. americanum, were similar to those obtained in 1986. P. neglectus showed the greatest 'R' value under corn, followed by M. brevidens, H. crenacauda, and X. americanum. As observed in 1986, adverse environmental conditions, such as soil temperature and soil moisture, adversely affected nematode populations, especially the ectoparasitic species.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTEO THIS PERIOO.

12.071* CRISO065796

DEVELOPMENT OF THE BASIC PARAMETERS FOR NEMATODE PEST MANAGEMENT DECISIONS

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.

Proj. No.: WNP00240 Project Type: HATCH

Agency IO: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extracting methodology for nematode detection and assessment; determination of the relationship between crop losses and nematodes as affected by environmental conditions; and determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: An in-depth sampling study in a center pivot irrigated potato field will be conducted to detect and assess Meloidogyne chitwoodi populations (eggs and juveniles). Factors to be investigated will include: number of subsamples/unit area; soil depth between 0-6'' time of sampling (weekly to monthly); soil type, and cropping sequence. Extraction procedures currently used in WA will be critically examined and compared to other methods to determine the most efficient extraction method and to quantify the level of efficiency. Population densities of M. chitwoodi and M. hapla will be manipulated by inoculation of cropping sequence in microplot and field trials to determine damage functins on several crops. Yield and/or quality of potato, carrots, beans and peas will be related

to initial population densities of the nematodes. The influence of environmental conditions and control strategies (crop rotation, resistant varieties and pesticides) on damage functions will be determined.

Progress: 87/01 to 87/12. Reproductive factor (Pf/Pi) of Meloidogyne chitwoodi (MC) race 2 on 44 crop cultivars ranged from 0-130. Nonhost crops (R=0) included asparagus, cowpea, lima bean, peanut, spearmint, strawberry and a hydrid turnip. Reproductive efficiency of MC race 1 and 2 was also compared on selected crop cvs. Both races failed to increase on 9 onion cvs. (R=0=-0.2) and R values on 9 corn cvs. ranged from 0.8-16.9. Alfalfa cvs. Nevada Syn XX and W12SR2W1 exhibited high degree of resistance to M. hapla (MH) and MC races 1 and 2. Population of individual plants of Nevada Syn XX were 100, 90, and 91% resistant to MH, MC1 and MC2, respectively, and W12SR2W1 55, 100 and 65% resistant. In field microplot studies the damage threshold level of MH on Chantenay Red Cored and Orlando Gold carrot was estimated to be 16.7 and 5.6/250 CM soil, respectively. Damage level for MC races was >2000/250 cm soil. Vertical migration studies in columns buried in the field showed that MC was able to migrate upwards from depths of 60, 120 and 180 cm to infect tomato roots. MC eggs and juveniles placed at 60 cm infected tomato roots within 30 days, while those placed at 120 and 180 cm were detected in tomato roots after 60 days. A total of 1.5 and 3-acre-inches water applied in 8 days was able to move ethoprop down only 10 to 20 cm, respectively, in conceptrations to control MC. Ethoprop at 0.62 mu g/g was able to prevent invastion by MC. Ethoprop EC at 6.7 AI ka/ha protected the treated zone from migrating nematodes for 5 weeks.

Publications: 87/01 to 87/12

PINKERTON, J.N., MOJTEHEDI, H., and SANTO, G.S. 1987. Reproductive efficiency of Pacific Northwest isolates of Meloidogne chitwoodi on alfalfa. Plant Disease 71:345-348.

PINKERTON, J.N., MOJTAHEDI, H., SANTO, G.S. and O'BANNON, J.N. 1987. Vertical migration of Meloidogyne chitwoodi and M. hapla under controlled temperature. J. Nematol. 19:152-157.

MOJTAHEDI, H., SANTO, G.S. and WILSON, J.H. 1987. Host range of Meloidogyne chitwoodi race 2 (alfalfa race). J. Namatol. 19(4) (Abstr.)

MOJTAHEDI, H., PINKERTON, J.N., SANTO, G.S. and PEADEN, R.N. 1987. Reproductive efficiency on Meloidogne chitwoodi race 2 and its pathogenicity on alfalfa cultivars. J. Nematol. 10(4) (Abstr.).

12.072* CRIS0091352

PATHOGENICITY, BIOLOGY AND CONTROL OF ROOT-KNOT NEMATODES ON IRRIGATED CROPS IN WASHINGTON

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.

Proj. No.: WNP00650 Project Type: HATCH
Agency ID: CSRS Period: 01 SEP 83 to 31 AUG 89

Objectives: Determine pathogenicity, damage and threshold levels; determine biology (population dynamics, vertical distribution, survival, migratory capabilities, life cycle, number of generations, host-parasite relationships, etc); and determine the efficacy of nematicides in relation to timing and application methods for controlling Meloidogyne chitwoodi and M. hapla.

Approach: Pathogenicity, biology and control studies will be conducted under controlled laboratory, greenhouse, field microplots, and/or natural field conditions. Naturally infested fields or pure root-knot nematode populations reared in the lab or greenhouse will be used to measure effects on plants. Soil used in tests will be free of other pathogens, except under natural field conditions. Experiments will be arranged in randomized block designs with 5 or more replicates. Experimental data to be collected will include measurements of crop yield and/or quality, plant growth, dry weight accumulation, nematode population dynamics in soil and plant tissue, and symptom expression. Environmental conditions including soil types, temperatures, moisture levels, length of growing season will be taken into account as they may affect the pathogenicity, biology and control of root-knot nematodes.

Progress: 87/01 to 87/12. Nematicide trials were conducted to evaluate chemicals for the control of Meloidogyne chitwoodi on potatoes. Treatmennts included fumigants and nonfumigants alone and in combinations; post-plant applications of non-fumigants to protect tubers at the time of nematode invasion; multiple applications of nonfumigants; and several application methods and rates were used to evaluate fumigants (Telone II, Vapam) and nonfumigants (Mocap, Nemacur, Temik, Vydate). Chemicals registered for use on potatoes as well as experimental compounds were evaluated. Excellent control was obtained with Telone II; fumigants in combination with Mocap; Mocap and Nemacur applied prior to planting and incorporated; and multiple post-plant applications of Mocap. Damage threshold studies show that M. hapla can reduce top growth of peppermint after two years at initial (Pi) inoculum levels of 500, 1,000, and 5,000 juveniles/250 cm soil. On Scotch spearmint growth reduction was observed at Pi of 5,000.

Publications: 87/01 to 87/12

SANTO, G.S., MOJTAEDI, H., PINKERTON, J.N. and WILSON, J.H. 1987. Biological control of root-knot nematodes on potato, 1987. Proc. of 26th Ann. Wash. State Potato Conf., pp. 57-59.

12.073 CRIS0143450

CARROT BREEDING AND EVALUATIONS TO DEVELOP AND INTRODUCE IMPROVED CULTIVARS FOR CALIF. PRODUCERS

SIMON P W; Agricultural Research Service, Madison, **WISCONSIN** 53702.

Proj. No.: 3655-21220-001-02R Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 88 to 31 MAR 89

Objectives: Develop superior carrot germplasm for California production. Attributes to be improved include pest (especially nematode) resistance, flavor, nutritional value, appearance, and yield.

Approach: Selected domestic and foreign carrot germplasm will be intermated to develop populations with improvements in several attributes. Resulting stocks will be intercrossed in pollinating cages to create hybrids for field testing. Methods for improving selection efficiency will be investigated. Funded by Fresh Carrot Advisory Board; funds to be administered by University of Wisconsin. NO FUNDS TO ARS.

12.074 CRIS0142963

EVALUATION OF DAUCUS GERMPLASM FOR RESISTANCE TO ROOT KNOT NEMATODE (MELOIDOGYNE HAPLA)

SIMON P W; MACGUIDWIN A E; Plant Pathology; University of Wisconsin, Madison, **WISCONSIN** 53706.
Proj. No.: 3655-21220-001-01S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 01 APR 88 to 30 SEP 88

Objectives: To evaluate resistance to root knot nematode of carrots among accessions ofwild and cultivated Daucus.

Approach: Cooperator will utilize standard technique to screen seedlings from 350 to 500 accessions for root knot nematode resistance. Nematode eggs will be added to soil eggs and gall damage will be measured, and data reported to the crop curator.

13.001* CRIS0082578
NEMATODE MANAGEMENT IN NURSERIES: DECIDUOUS FRUITS, NUTS, VINES AND BERRIES

MAGGENTI A R; RASKI D J; WESTERDAHL B B;
Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4038-H Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 87 to 30 SEP 91

Objectives: To develop and maintain nematode free quality planting stock for California orchards, vineyards and berry plantings. We will continue to investigate and develop effective and economical nematode management programs for the control of nematodes in field grown nursery stock.

Approach: A wide variety of management programs will be investigated. Among these will be chemical dips, hot water treatments, and cultural modification such as crop rotation, resistant varieties and rootstocks. Effective and economical field soil treatments will also be investigated.

Progress: 87/01 to 87/12. A. Ph.D. thesis was completed by John Griesbach. The research was concerned with the validity of the species of Xiphinema californicum that was separated out of X. americanum by Lamberti in 1979. This action created a great deal of confusion concerning nematode vectored viruses in California. X. californicum was collected from ten sites throughout the southern half of the state. These populations were used to establish vector specificity with the NEPO viruses that X. americanum sensu lato is known to transmit. The morphometric variability of the populations after being grown on the same host, were through discriminant analysis compared to type specimens and congenerics from California. It was concluded that X. californicum is a synonym of X. americanum. This was an important finding that clarified and verified the vector of the ringspot viruses in California.

Publications: 87/01 to 87/12
GRIESBACH, J. 1987. The morphometrics and vector specificity of Xiphinema americanum sensu lato in California. Ph.D. Thesis.

13.002* CRIS0057795
DETECTION, BIOLOGY & CONTROL OF NEMATODES INCITING DISEASES OF AVOCADO, CITRUS, ORNAMENTALS & TURF

VAN GUNDY S D; RADEWALD J D; BALDWIN J G;
Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-2708 Project Type: STATE
Agency ID: SAES Period: 01 JUN 84 to 30 SEP 89

Objectives: To detect and to determine pathogenicity and biology of various nematodes associated with ornamentals, turf, citrus and avocado. To seek means of control of pathogenic nematodes on these crops through the most efficient usage of new and established nematicides or cultural practices. To evaluate potential varieties or rootstocks for nematode resistance. To provide research on CDFA quarantine and nursery registration programs.

Approach: Survey problem areas of ornamentals, turf, citrus and avocado and determine if nematode pests are involved. If nematodes are suspect as a causal agent of the disease, determine if they are pathogenic and develop economical and reliable means of control through biological cultural means, resistant varieties, or chemicals. Target pests will be studied in isolated quarantine facilities.

Progress: 87/01 to 87/12. Postplant studies conducted with drip irrigation systems for citrus nematode demonstrated two materials, Nemacur and CY81 provided an economic level of control. Additionally, GY81 provided a degree of control of Phytophthora that warrants further investigation. A label change for Nemacur, lessening the time between treatment and harvest (30 days instead of 180 days) along with Nemacur's performance, in all likelihood will make this product a strong candidate for grower useage. Work on morphologic variation and taxonomy of Punctodera in Mexico, Canada, and the U.S. has included investigation of populations apparently pathogeneic on golf greens in the San Francisco area. In addition, we continue investigation of physiologic variation of Radopholus species, including serious pests of citrus and many ornamentals. Recent studies indicate physiologic homogeneity of this nematode in Mexico and confirm that populations in Mexico are not a pathogens to citrus. Ecology studies on the citrus nematode suggest that larvae and males are not active at all times in irrigated groves. The citrus nematode has weak anhydrobiotic survival strategies when confronted with water stress. Studies on parasitism and carbohydrate partitioning are continuing as are studies for resistance to the citrus nematode in new citrus crosses with citrus relatives. An artificial feeding system is being developed for Hemicycliophora arenaria.

Publications: 87/01 to 87/12
MUNDO-OCAMPO, M. and BALDWIN, J.G. Physiological homogeneity of the burrowing nematode in Mexico. J. Nematol. 19:545. Abstr.

13.003* CRIS0085692
DEVELOPMENT OF ENTOMOPATHOGENS FOR USE IN PEST MANAGEMENT SYSTEMS

CAPINERA J L: Entomology; Colorado State University, Fort Collins, **COLORADO** 80523.
Proj. No.: COL00227 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To evaluate and optimize efficacy of entomopathogenic formulations.

Approach: Efficacy determinations for utilization of entomophagous nematodes in Colorado crop and urban pest situations will be made. Included will be investigations on selection and development of appropriate application timing and evaluation of cultural practices on efficacy. Methods of increasing infectivity (potency) and field stability also

will be explored.

Progress: 87/01 to 87/12. Trials were conducted with N. carpocapsae (Mexican) for control of immature flies infesting bedding plants (fungus gnats, shore flies and moth flies). Nematode treatments failed to reduce the number of adult flies emerging from potted media. Field Trials: The entomogenous nematodes, N. carpocapsae (50k/ft and H. heliothidis (50k/ft), were applied to turf infested with the white grub Cyclocephala sp. The application resulted in a significant decrease from the of grubs found in the control plots. (Pueblo). Field Trials: Corn earworm. The entomogenous nematode, N. carpocapsae "Breton" was applied to sweetcorn to determine levels of efficacy in controlling corn earworm Heliothis zea. Corn earworm mortality was found to be significantly higher in those plots in which the nematodes were applied to the corn ears.

Publications: 87/01 to 87/12

CAPINERA, J.L. 1987. Observations on natural and experimental parasitism of insects by Mermis nigresceus Dujardin (Nematoda: Mermithidae). J. Kansas Entomol. Soc. 60: 159-162.

13.004 CRIS0141587
EVALUATION OF FENAMIPHOS, METALAXYL, AND VYDATE IN DISEASE MANAGEMENT OF ORNAMENTALS

KAPLAN D T; Agricultural Research Service, Orlando, **FLORIDA** 32804.
Proj. No.: 0500-21010-007-40D
Project Type: INHOUSE
Agency ID: ARS Period: 16 MAY 86 to 30 SEP 89

Objectives: Determine influence of fenamiphos on nematode population densities and plant growth in camellia, impatiens, and chrysanthemum. Evaluate phytotoxicity of vydate on cactus. Determine efficacy of metalaxyl in root rot management in ficus.

Approach: Greenhouse and field evaluations include infestation of rooting media, treatment with 4 rates, periodic sampling and evaluation of pathogen densities, and plant growth.

Progress: 87/01 to 87/12. The effect of metalaxyl on Phytophthora and Pythium was evaluated on Ficus benjimina and F. pimula under greenhouse conditions. Data awaits analysis. Camelia japonica was not susceptible to any of three races of Meloidogyne incognita nor M. javanica. Furthermore, Radopholus similis did not damage C. japonica root systems. Therefore, fenamiphos will be evaluated only for phytotoxicity in field and containerized camelias. Pathogenic isolates of Phythopthora parasitica were identified for snapdragon, philodendron, and zinnia. None of fifteen isolates of Phytophthora was pathogenic to dieffenbachia, peperomia or salvia. Aliette (foliar spray and soil drench) is presently under evaluation for root and crown rot control and for phytotoxicity evaluation in snapdragon, philodendron, and zinnia. Radopholus citrophilus, M. incognita, and M. javanica were not pathogenic to rose. Pratylenchus brachyurus and P. coffeae are presently under evaluation as pathogens of rose.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

13.005* CRIS0141452
BIOREGULATION OF INSECT-PLANT INTERACTIONS

MAYER R T; SCHROEDER W J; SHAPIRO J P; Agricultural Research Service, Orlando, **FLORIDA** 32804.
Proj. No.: 6617-24000-004-00D
Project Type: INHOUSE
Agency ID: ARS Period: 28 MAY 86 to 27 MAY 91

Objectives: Determine effect of plant products on insect reproduction, feeding, digestion, hormones, and chitin metabolism. Characterize vector relationships and phytoalexins in resistant plants. Identify and characterize biological control agents for insect pests, and develop control systems for their application.

Approach: Involves use of diverse techniques including methods in histology, electrophoresis, spectroscopy, fluorimetry and bioassay and immunoassay (ELISA, RIA, SSEM, fluorescent antibody), microscopy (TEM, SEM, LM), probes(dsRNA, antibody, fluorescent, and cDNA), centrifugation, chromatography (affinity, TLC, gel, HPLC), microscopy, isotopes, hemagglutination, and hybridomas.

Progress: 87/01 to 87/12. A bioassay was developed using Mexican lime leaves on an agar media in petri dishes that allows assessment of virulence of Verticillium sp. against citrus aphids; the assay is facile and provides a more rapid method for determination of fungal biocontrol agents to control citrus aphids. Use of a nematode (Steinernema feltiae) isolated from infected larvae of Diaprepes abbreviatus coupled with a new method to increase the efficacy of the entomogenous nematode was shown to reduce citrus root weevil populations to economic threshold levels not previously attainable. These methods will be of interest to all biocontrol programs that utilize nematodes as the biocontrol agents and to the citrus industries in Florida and the Caribbean Basin. Spectrofluorometric studies showed that natural and synthetic xenobiotics (coumarins) are absorbed by hemolymph proteins after ingestion. A model system was subsequently developed to observe binding to hemolymph proteins in vivo and in vitro and to determine if it is possible to alter the dynamics of binding and absorption such that a control method can be developed. An in vitro, cell-free assay for chitin synthase has been developed utilizing gut tissue from D. abbreviatus larvae; this method will allow for testing of chitin synthesis inhibitors against the citrus root weevil and for investigations on the chitin metabolic pathway in this insect.

Publications: 87/01 to 87/12

SCHROEDER, W.J. 1987. Laboratory bioassays and field trials of entomogenous nematodes for control of Diaprepes abbreviatus

(Coleoptera: curculionidae) in citrus. Environ. Entomol. 16:987-989.
SCHROEDER, W.J. and BEAVERS, J.B. 1987. Movement of the entomogenous nematodes of the families heterorhabditidae and steinernematidae in soil. J. Nematol. 19(2):257-259.
SCHROEDER, W.J. 1987. Induced pupation in Diaprepes abbreviatus (Coleoptera: curculionidae). Fla. Entomol. 70(1):186-187.
SHAPIRO, J.P. 1988. Isolation and fluorescence studies on a lipophorin from the weevil Diaprepes abbreviatus. Arch. Insect Biochem. Physiol. (Accepted December 1987).
CHEN, A.C., KIM, H.R., MAYER, R.T. and NORMAN, J.O. 1987. Vitellogenesis in the stable fly, Stomoxys calcitrans. Comp. Biochem. Physiol., 88B(3):897-903.
MAYER, R.T. et al. Evidence that chitin synthesis inhibitors affect cell membrane transport. Proc. Intern. Conf. on Endocrinological Frontiers in Physiological Insect Ecology. (Accepted September 1987).
SHAPIRO, J.P., LAW, J.H. and WELLS, M.A. 1988. Lipid transport in insects. Annu. Rev. Entomol. 33:297-318.

13.006* CRIS0132201
BIOLOGICAL CONTROL OF PEST MOLE CRICKETS

FRANK J H; WALKER T J; BOUCIAS D G; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02636 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To improve methods for laboratory culture of the mole crickets Scapteriscus vicinus and S. acletus. To complete evaluation of the effectiveness of the Uruguayan strain of the parasitic nematode Neoaplectana carpocapsae as a biological control agent of Scapteriscus mole crickets, and to develop economically feasible field application methods. To complete evaluation of the effectiveness of the parasitic wasp Larra bicolor as a biological control agent of Scapteriscus mole crickets, and to investigate other Larra species. To perform laboratory and field evaluations of fungal, viral, and microsporidan pathogens of mole crickets.

Approach: To devise a method for successful laboratory colonization and evaluate production of the tachinid fly Euphasiopteryx depleta. To study the life cycle of as many species of the bombardier beetle genus Pheropsophus as possible in quarantine, and to determine which, as larvae, are specialized predators of mole cricket eggs.

Progress: 87/10 to 88/09. The parasitic nematode (Neoaplectana sp., Steinernematidae) from Uruguay which was first released in Florida in 1985 continues to suppress mole cricket populations at the sites of release. It has turned up at a control site >1 km from a release site, presumably spread there by infected mole crickets. Results of field studies at Ft. Lauderdale, Florida, where the parasitic wasp Larra bicolor (Hymenoptera: Sphecidae) has been established since 1981, show that the wasp parasitizes Scapteriscus abbreviatus in the field, with no evidence of parasitism of S. acletus or S. vicinus. An iridovirus detected in Scapteriscus acletus in southern Brazil where it was causing an epizootic has characteristics which do not match those of any described iridovirus. No iridovirus has been reported previously from an orthopteran host, and this one is a potential biocontrol agent for mole crickets if it proves to be safe to non-target organisms. Adult females of the parasitic fly Euphasiopteryx depleta (Diptera: Tachinidae) were trapped in southern Brazil routinely from mid-October 1987. Some of the flies were carried to a quarantine facility in Florida in November 1987 where larvae dissected from them were inoculated onto mole crickets. Many of the larvae developed successfully and some of the resultant adults mated successfully in the laboratory for the first time. Over 200 puparia of a following generation were released in Alachua Co., Florida, in late April 1988, and over 200 at the beginning of June.

Publications: 87/10 to 88/09
BOUCIAS, D.G., MARUNIAK, J.E. and PENDLAND, J.C. 1987. Characterization of an iridovirus isolated from the southern mole cricket, Scapteriscus vicinus. J. Invert. Pathol. 50: 238-245.
CASTNER, J.K. 1988. Biology of the mole cricket parasitoid Larra bicolor (Hymenoptera: Sphecidae) (p. 423-432 in) GUPTA, V.J. (ed.) Advances in parasitic Hymenoptera Research, 1988. Brill, Leiden (in press).
FOWLER, H.G. 1987. Field behavior of Euphasiopteryx depleta (Diptera: Tachinidae): phonotactically orienting parasitoids of mole crickets (Orthoptera: Gryllotalpidae: Scapteriscus). J. New York Ent. Soc. 95: 474-480.
FOWLER, H.G. 1987. Field confirmation of the phonotaxis of Euphasiopteryx depleta (Diptera: Tachinidae) to calling males of Scapteriscus vicinus (Orthoptera: Gryllotalpidae). Florida Ent. 70: 409-410.
FRANK, J.H. and SMART, G.C. 1988. The parasitic nematode Neoaplectana n. sp. as a biological control agent of mole crickets (p. 25-29 in) Report of turfgrass research supported by the FTGA 1987-1988. Univ. Florida, IFAS, i + 47 p.

13.007 CRIS0136670
HOST-PARASITE RELATIONSHIPS OF NEMATODES ON LANDSCAPE ORNAMENTALS

MCSORLEY R T; DUNN R A; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02708 Project Type: STATE
Agency ID: SAES Period: 03 OCT 88 to 30 SEP 93

Objectives: To review and summarize existing literature on nematodes affecting ornamentals. To determine the susceptibility of selected perennial foliage and landscape ornamentals and annual bedding plants to several of the more

serious pathogenic nematodes common in Florida. To develop damage functions for selected nematodes on annual bedding plants.

Approach: Pertinent literature on nematodes affecting ornamentals will be reviewed and summarized in technical bulletins. In greenhouse tests, selected ornamentals will be inoculated with populations of root-knot and/or sting nematodes according to a specified protocol. Plant growth and ability to support nematode populations will be evaluated at specified intervals. Susceptible ornamentals will be inoculated with a range of nematode densities to derive damage functions.

13.008* CRIS0095463
TRICKLE IRRIGATION IN HUMID REGIONS

OVERMAN A J; STANLEY C D; CSIZINSZKY A A; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 34203.
Proj. No.: FLA-BRA-02487 Project Type: HATCH
Agency ID: CSRS Period: 12 DEC 84 to 30 SEP 89

Objectives: To determine crop water requirements and optimum crop and water management methods for trickle irrigation in humid regions. To develop basic guidelines and procedures for applying nutrients and pesticides and determine water and chemical distribution patterns in relation to root systems. To develop specific design criteria and procedures for trickle systems in humid regions: a) to evaluate design application rates; b) to evaluate number and location of emitters; c) to characterize the hydraulic principles for proper and efficient system operation; and d) to determine optimum system configuation with regard to cultural and management practices.

Approach: Row crops of vegetables and ornamentals will be grown with drip irrigation systems varying frequency and volume, introducing pesticides and nutrients, evaluating placement of water and potential minimal irrigation levels in both spring and fall growing seasons on sandy soil.

Progress: 87/10 to 88/09. Nemagation: Methyl bromide 98%/chloropicrin 2% (.25 or .5 kg 30 m- row) injected as a dry gas into a biwall tube buried 7 cm deep mid-bed increased a primary mulched tomato (Lycopersicon esculentum Mill cv. Sunny) crop on sandy soil 33 or 58%, respectively, & in a double crop mode where plastic was no longer a complete film, the low rate increased yield 31%. Five genera of nematodes inhabited the soil: 98 days after nemagation populations of Belonolaimus, Tylenchorhynchus, Meloidogyne & Dolichodorus were still not detectable within 30 cm of the tube in rhizosphere of either tomato crop. Trichodorus in treated soil was estimated at 50% of the control in the primary crop & at 300% of the control in the double crop. The effect of N-sources, forms & rates were compared on plant growth, yield & fruit quality of drip irrigated tomatoes grown with the full-bed mulch system. Nitrogen sources & combinations were 80% NO(3) + 20% NH(4) or 25% NO(3) & 75% NH(4). Nitrogen forms were 100% liquid injected through the trickle tube, 20% pre-plant dry + 80% liquid & 33% pre-plant dry + 67% liquid. Rates were 185, 230 and 275 kg ha- N. No significant differences in plant growth, fruit yield and fruit quality were associated with any of the treatments. Water movement monitored for different application rates in a moist soil profile (EauGallie fine sand) indicated lateral movement from an emitter was limited to 20-25 cm from the emitter when maintaining applied water within the top 25 cm of the profile.

Publications: 87/10 to 88/09

CSIZINSZKY, A.A. and STANLEY, C.D. 1987. Sequential cropping of vegetables with combined seep and drip irrigation. HortScience 22:1052. (Abstr.).
CLARK, G.A., STANLEY, C.D. and SMAJSTRLA, A.G. 1987. Micro-irrigation on mulched bed systems: components, system capacities, and management. IFAS, Univ. of Fla., Bull No. 245.
CSIZINSZKY, A.A., STANLEY, C.D. and OVERMAN, A.J. 1987. Response of two tomato cultivars to irrigation systems, fertilizer sources, and plant spacings for three consecutive seasons. Proc. Soil and Crop Sci. Soc. Fla. 46:1-4.
CSIZINSZKY, A.A. and STANLEY, C.D. 1987. Effect of nitrogen source and plant spacing on cauliflower production with trickle irrigation. Proc. Soil and Crop Sci. Soc. Fla. 46:84-88.
OVERMAN, A.J., CSIZINSZKY, A.A., JONES, J.P. and STANLEY, C.D. 1987. Efficacy of metam sodium applied via drip irrigation on tomato. Proc. Soil and Crop Sci. Soc. Fla. 46:4-7.
OVERMAN, A.J. and HARBAUGH, B.K. 1988. Water use in caladium tuber production. Proc. Fla. State Hort. Soc. (In Press).
OVERMAN, A.J. 1988. Chemigation for a second crop of tomato on micro irrigated sandy soil. ESN 19th International Nematode Symp. Nematologica 34: (In Press). (Abstr.).

13.009 CRIS0136669
HOST-PARASITE RELATIONSHIPS OF NEMATODES ON LANDSCAPE ORNAMENTALS

GIBLIN-DAVIS R M; Citrus Res & Education Center; University of Florida, Ft Lauderdale, **FLORIDA** 33314.
Proj. No.: FLA-FTL-02708 Project Type: STATE
Agency ID: SAES Period: 03 OCT 88 to 30 SEP 93

Objectives: To review and summarize existing literature on nematodes affecting ornamentals. To determine the susceptibility of selected perennial foliage and landscape ornamentals and annual bedding plants to phytoparasitic nematodes in Florida. To develop damage functions for selected nematodes or annual bedding plants.

Approach: Pertinent literature on nematodes affecting ornamentals will be reviewed and summarized in technical bulletins. In

greenhouse tests, selected ornamentals will be inoculated with populations of sting and/or Root-Knot nematodes according to a specified protocol. Plant growth and ability to support nematode populations will be evaluated at specific time intervals. Susceptible ornamentals will be inoculated with a range of nematode densities to derive damage functions.

13.010* CRIS0142676
NEMATODE AND DISEASE CONTROL ON MINOR FOOD CROPS AND ORNAMENTALS

JOHNSON A W; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 0500-21010-007-52D
Project Type: INHOUSE
Agency ID: ARS Period: 09 FEB 88 to 08 FEB 93

Objectives: To evaluate the effectiveness and phytotoxicity of nematicides and fungicides for control of nematodes and diseases on minor food crops and ornamentals in the South.

Approach: Field and/or greenhouse tests will be conducted under good laboratory/fieldprocedures to determine the effects of nematicides and fungicides on nematodes and diseases of minor crops and ornamentals. Nematode populationswill be monitored and disease damage, crop response and yields will be recorded. Mature fruit and/or plant parts will be analyzed for pesticide residues. Plant species, chemicals and treatment rates are determined by Minor Use Pesticide protocols. Date will be summarized, analyzed, and reports will be submitted to IR-4 Headquarters to support registration for nematicides and fungicides on minor food crops and ornamentals.

13.011* CRIS0140338
NEMATODE AND INTEGRATED PEST MANAGEMENT SYSTEMS FOR THE SOUTHEASTERN COASTAL PLAIN

JOHNSON A W; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 6602-24000-007-00D
Project Type: INHOUSE
Agency ID: ARS Period: 02 AUG 85 to 01 AUG 90

Objectives: Develop integrated pest management systems and models that are effective, energy efficient and economically suitable for managing and predicting populations of plant-parasitic nematodes in intensive vegetable and agronomic cropping systems under irrigation.

Approach: Field tests (using standard and new techniques) will be conducted to determine the effects of cultural practices, crop rotations, cover crops, resistant varieties, tillage methods, irrigation, chemicals and levels of pest management on nematodes, soil-borne fungi, insects, and weeds on intensive horticultural and agronomic crop production systems. Nematode population densities, root-gall indices, seedling diseases, crop response, yield and quality will be recorded. The fate and efficacy of nematicides in soil and groundwater will be determined. The research will be conductedin cooperation with agricultural engineers, agronomists, horticulturists, economists, entomologists, plant pathologists, weed scientists, modelers, and research chemists.

Progress: 87/01 to 87/12. Numbers of root-knot nematode juveniles in intensive cropping systems were <5/150 cc soil in all plots of vegetable crops, except onion and cowpea, following tobacco, and lettuce following sweet corn. The nematode species were 100% Meloidogyne incognita on onion and lettuce, and 70% M. incognita and 30% M. arenaria on cowpea. Numbers of root-knot nematodes were <25/150 cc soil in plots of soybean, cotton, peanut and winter oats prior to planting spring crops. Yields of millet, a potential new crop for the Southeast, were 74% greater in nonirrigated plots treated with fenamiphos and low fertility than yields from similar irrigated treatments. Risk efficient action thresholds have been developed for lesion nematodes on corn. The GLEAMS model (Groundwater Loading Effects of Agricultural Management Systems) was modified to simulate the generation and degradation of pesticide metabolites. GLEAMS-simulated mass of fenamiphos, f. sulfoxide, and f. sulfone in the rhizosphere compared favorably with field data within the variability of observed data. Results from a field test to determine the efficacy of fenamiphos (73.1% in propylene glycol) mixed with Terpine (Unitrol 90) in a 1:1 ratio and fenamiphos (3 SC) applied at 3.3 and 6.6 kg/ha through an irrigation simulator with 0.62 cm of water indicated that lower dosages of fenamiphos and different formulations may provide adequate nematode control, optimum yield, and reduce potential for soil and groundwater pollution.

Publications: 87/01 to 87/12

BURTON, G.W., and JOHNSON, A.W. 1987. Coastal bermudagrass rotations for control of root-knot nematode. J. Nematol. 19:138-140.
JOHNSON, A.W. et al. 1987. The biologic and economic assessment of registered fumigants. USDA Series. 169 pp.
PAYAN, L.A., JOHNSON, A.W., and LITTRELL, R.H. 1987. Effects of nematicides and herbicides alone or combined on Meloidogyne incognita egg hatch and development. Annals of Applied Nematology 1:67-70.
JOHNSON, A.W. et al. 1987. Bibliography of estimated crop losses in the United States due to plant-parasitic nematodes. By: Society of Nematologists Crop Loss Assessment Committee. J. Nematol. 1:6-12.
JOHNSON, A.W. 1987. Nemagation via overhead irrigation. J. Nematol. 19:533. (Abstract).
JOHNSON, A.W., CSINOS, A.S., GLAZE, N.C., and GOLDEN, A.M. 1987. Cochemigation for multiple pest control on tobacco. J. Nematol. 19:533. (Abstract).
JOHNSON, A.W. et al. 1987. Nematicides - A Historical Review. IN J.A. Veech & D.W. Dickson (Eds.) Vistas on Nematology: A Commemoration of the 25th Anniv. of the

Soc. of Nematol. pp. 448-454. E.D. Painter Prtg. Co., De Leon Springs, FL.

13.012 CRIS0090077
ETIOLOGY AND CONTROL OF DISEASES OF WOODY ORNAMENTAL PLANTS GROWN IN GEORGIA

WALKER J T; Plant Pathology; Georgia Agric Expt Station, Experiment, **GEORGIA** 30212.
Proj. No.: GED01349 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 83 to 30 SEP 88

Objectives: To determine the etiology of scorch symptoms on selected woody ornamentals. To evaluate the impact of water and temperature stress on azalea and Japanese holly relative to their susceptibility to Phomopsis and plant parasitic nematodes, respectively. To determine the susceptibility of woody ornamental cultivars to selected fungal, bacterial, or nematode pathogens. To develop disease control strategies for woody ornamentals under nursery and homeowner environments.

Approach: Standard pathological procedures of isolation, inoculation, and incubation will be utilized for studying suspected causal agents and fulfilling Koch's postulates. Specialized media will be necessary for achieving in vitro growth of certain organisms. Environmental effects, primarily water and temperature, on susceptibility of containerized plants to fungus and nematode pathogens will utilize growth chambers and field microplots. Cuttings of various woody cvs. will be screened for susceptibility at several temperature regimes at high moisture. Experimental pesticides will be compared with registered chemicals, with and without adjuvants. Spray applications and equipment refinements will be made under simulated nursery conditions.

Progress: 87/01 to 87/12. Phomopsis, the fungus causing dieback of azalea, was recovered from 54% of azalea stems with natural symptoms. When inoculated with Phomopsis conidia vascular discoloration resulted in all wounded stems. Over 50% of the flower blossoms or buds were infected following inoculation; leaf scars had an infection rate of 70% and leaves 4%. Conidial germination rate was highest in free water at 30C. Df 15 fungicides inhibiting Phomopsis, prochloraz and propiconazole were inhibitory as low as 0.05 mu g ml and benomyl was inhibitory at 0.50 mu g ml . Based on asci, ascospore measurements, perithecia, and colony morphology the perfect state of Phomopsis was identified as D. medusaea. Root-knot nematode infested Impatiens plants had greater water potential and fewer plants wilted than nematode-free plants ninety six hours after watering ceased. This suggests that water conservation mechanisms may exist in infected plants although root dry weights were significantly reduced by nematodes. Four different spray nozzles were tested at two pressures to determine the effect of spray droplet distribution on Photinia leaf-spot development. Differences in disease control occurred at the end of season when the same amount of systemic fungicide was applied; nozzles delivering lower volume per unit time resulted in best disease control. Spray pressures of 83-110 x 10 Pa were little different than pressures at 138-152 x 10 Pa in effects on disease.

Publications: 87/01 to 87/12
ROBERTS, D.R., JR. 1987. Possible modes of infection and control of Phomopsis dieback of azalea. M.S. Thesis University of Georgia, Athens, 73 p.

13.013 0139714
BIOLOGICAL CONTROL OF LIRIOMYZA LEAFMINERS WITH ENTOMOPATHOGENIC NEMATODES

HARA A H; KAYA H K; GAUGLER R; Entomology; University of Hawaii, Honolulu, **HAWAII** 96822.
Proj. No.: HAW00972-G
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 89 to 30 JUN 90

Objectives: Isolate naturally-occurring entomopathogenic nematodes in Hawaiian soils and determine their pathogenicity to Liriomyza spp. Genetically select a nematode strain for enhanced host preference to Liriomyza spp. Determine laboratory and field efficacy of naturally-occurring and genetically-modified nematodes. Integrate chemical insecticides, parasitoids and nematodes in a compatible manner for effective management of Liriomyza spp. and other pests.

Approach: Ecologically diverse soils of the major Hawaiian Island will be sampled in an attempt to isolate naturally-occurring entomopathogenic nematodes. Series of laboratory assays will be conducted to determine the concentration and strain of infective stage nemtodes likely to achieve high rates of Liriomyza mortality in the field. Foliar and drench applications of nematodes against Liriomyza and other insect pests will be conducted in greenhouse and field conditions.

13.014 0145354
CONTROL OF PLANT PESTS AND PATHOGENS WITH BY-PRODUCTS OF NEEM SEED

LAREW H G; LOCKE J C; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-064-05T
Project Type: INHOUSE
Agency ID: ARS Period: 01 JUL 89 to 30 JUN 91

Objectives: To conduct research on the efficacy of neem by-products in control of insect pests, soilborne and foliar plant pathogens, and nematodes in developing new approaches to control with the use of the botanical pesticide neem.

Approach: Investigate neem oil and neem by-products for efficacy in protecting plants from attack by insect pests in evaluation of foliar sprays and soil drenches. Study the effect of neem seed cake by-product on Pythium

and Rhizoctonia. Evaluate the influence of neem by-products as soil amendments on populations of pathogenic nematodes.

Progress: 89/07 to 89/12. Efficacy evaluations, using several crude neem seed extraction by-products, on fungal pathogens and insect pests have shown substantial activity. This broad based activity has been further evaluated using partially formulated preparations. Further evaluations are underway using several model systems. The importance of developing these natural product alternatives to "hard pesticides" is in light of the current regulations being imposed on existing pesticides and the limited future of many of the products on which the ornamentals industry depends.

Publications: 89/07 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

13.015* CRIS0027934
PLANT DISEASE SURVEY AND SPECIAL INVESTIGATIONS

WYSONG D S; WATKINS J E; BOOSALIS M G; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-21-001 Project Type: STATE
Agency ID: SAES Period: 01 JUL 66 to 13 MAR 89

Objectives: Monitor plant disease occurrence; determine casal agents of new diseases; deliniate geographic distribution of new and recurring diseases on a periodic basis; make preliminary studies on severity of new or certain recurring diseases; develop judments on feasibility of short-term versus long-term investigations on certain diseases.

Approach: Conduct periodic field examinations for diseases on field crops with particular attention to alfalfa, corn, sorghum, soybeans and wheat; record and maintain records of pathogen identification, disease severity and location, host, and other pertinent data; conduct further study of specific plant diseases collected on survey; study applicability of practical control measure for economically important diseases.

Progress: 87/01 to 87/12. SOYBEANS: A soybean cyst nematode (SCN) survey was conducted in an 8-county area bordering the Missouri River between Richardson County on the south and Burt County on the north. A total of 130 soybean fields were included in the survey, which was initiated in late July and completed in mid-August, 1987. Assays of soil and plant roots collected on survey resulted in the identification of 13 "new" infested fields. The number of fields surveyed by county and the number of confirmed SCN fields (in parentheses) is as follows: Richardson - 20 (4), Nemaha - 20 (2), Otoe - 20 (1), Cass 10 (1), Sarpy - 13 (2), Douglas - 7 (1), Washington - 20 (0), and Burt - 20 (2). While all of the infested fields are associated with low-lying, river bottomland soils, four of the fields were located in the central or western sections out of the Missouri floodplain region. Three of these fields were in Richardson and one was in Douglas counties. SORGHUM: A sorghum downy mildew survey was conducted in a 35-county area in south central, east central and southeastern Nebraska in order to determine the incidence and severity of the disease in commercial fields. A minimum of four fields were selected at random in each county. The disease was found to occur in 17 of the 35 counties; it was considered severe and, in a few fields, was felt to be yield-limiting in a four-county area including Nuckolls, Thayer, Fillmore and Clay counties.

Publications: 87/01 to 87/12
POWERS, T. and WYSONG, D.S. 1988. Soybean Cyst Nematode in Nebraska. Crop Prot. Clinic Proc., pgs. 146-148.
JENSEN, S.G., WYSONG, D.S. and DOUPNIK, B., JR. 1988. Sorghum Downy Mildew, The Disease and its Control. Crop Prot. Clinic Proc., pgs. 123-127.

13.016 CRIS0097722
INTERACTIONS OF SOIL INSECTS, CONTROL AGENTS AND THE ENVIRONMENT IN TURF SYSTEMS

VILLANI M G; Entomology; N Y Agricultural Expt Station, Geneva, **NEW YORK** 14456.
Proj. No.: NYG621359 Project Type: STATE
Agency ID: SAES Period: 01 JAN 86 to 31 DEC 90

Objectives: Evaluate independently and in concern chemical and biological insecticides nematodes and microbials for efficacy against soil pests of turf and other horticultural commodities in New York State. Monitor the interaction of target species, control agents and the soil environment to increase efficacy of control tactics and added to the basic understanding of the soil ecosystem.

Approach: Chemical and biological insecticides will be evaluated for efficacy and alteration of pest target behavior through a variety of destructive and non-destructive sampling techniques in the laboratory, greenhouse and field.

Progress: 88/01 to 88/12. Studies were conducted to determine the efficacy of indigenous isolates of entomopathic fungi in controlling members of the scarab grub complex infesting NY State turfgrasses. Studies were initiated on comparisons of spore and mycelium formulations of Metarhizium anisopliae isolated in our collection of Japanese beetle grubs in NYS. Early indications suggest that the mycelium formulation out-performs the spore formulation of this isolate in the laboratory, and that soil moisture rather than soil temperature may be the most important initial factor in epizootic spread. European chafer larvae were most susceptible to Beauveria brongniartii, while Japanese beetle larvae were most susceptible to Metarhizium anisopliae. Oriental beetles were equally susceptible to both fungal isolates. Data from a subsequent bioassay on the effects of soil temperature and moisture on B. brongniartii-induced mortality of chafer larvae indicated highest mortality occurred among hosts incubated in soil at high temperature and low moisture, conditions that were most stressful to the grubs. Sporulation

from diseased cadavers was strongly related to the low temperature environment. The effects of the same soil environmental variables on M. anisopliae-induced mortality among Japanese beetle larvae indicated moderate grub mortality occurred in soil held at low temperature and low moisture, while high mortality was seen for all other treatment combinations.

Publications: 88/01 to 88/12

WRIGHT, R. J., VILLANI, M. G. and AGUDELO-SILVA, F. 1988. Steinernematid and heterorhabditid nematodes for control of larval European chafers and Japanese beetles (Coleoptera: Scarabaeidae) in potted yews. J. Econ. Entomol. 81(1): VILLANI, M. G., WRIGHT, R. J. and BAKER, P. B. 1988. Differential susceptibility of Japanese beetle, Oriental beetle, and European chafer (Coleoptera: Scarabaeidae) larvae to five soil insecticides. J. Econ.
VILLANI, M. G. and WRIGHT, R. J. 1988. Entomogenous nematodes as biological control agents of European chafer and Japanese beetle (Coleoptera: Scarabaeidae) larvae in turf. J. Econ. Entomol. 81(2): 484.

13.017* CRIS0070699

DAMAGE POTENTIAL AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03546 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Elucidate damage potential of nematodes, especially variable races of Meloidogyne incognita (MI) and M. Arenaria; determine impact of environment on related damage to tobacco and soybean; characterize spatial and temporal populations of nematode; develop and evaluate control tactics; monitor nematode communities species changes; and integrate information on MI on soybean into a simulator.

Approach: Field and microplot experiments will focus on "determinants" involved in nematode-induced crop losses. Evaluate utility of "nematode hazard indices" and economic thresholds. Incorporate data on soybean responses to MI into "CIPM" model. Study biochemical basis of differential virulence and resistance to Meloidogyne spp. on tobacco and mechanisms of nematode suppression of nodulation on soybean. Use findings to improve sampling procedures for advisory purposes. Direct cooperative research toward improving control tactics.

Progress: 87/01 to 87/12. Meloidogyne arenaria (MA) caused more severe damage to peanuts than M. hapla in an interaction study in microplots. Populations of MA differed in their virulence on tobacco. This species, M. hapla, and M. javanica had slight to no effect on the activity of M. incognita (MI) on resistant tobacco. Greenhouse evaluations showed a number of "USDA" tobacco lines to have resistance to one or more of these nematodes. These four root-knot species were found to have differential sensitivity to certain nematicides. Moisture levels affected MI-induced gall development on tobacco as well as leaf growth. Young plants and feeder roots of older Asparagus were found to be susceptible to this nematode. Older roots of this host apparently are resistant to MI. Sphaeronema sasseri and Pratylenchus macrostylus were widespread on Fraser fir and red spruce in the Black Mountains, NC. Both nematode species have low temperature optima.

Publications: 87/01 to 87/12

BARKER, K. R. 1987. Effects of irrigation and cultivar on growth and yield response of tobacco to aldicarb. J. Nematol. 19:511 (Abstr.).
BARKER, K. R., and NOE, J. P. 1987. Establishing and using threshold population levels. In Vistas on Nematology, p.75-81. Veech, J.A., and D.W. Dickson (eds.). Society of Nematologists. E. O. Painter Printing Co., FL.
BARKER, K. R., and NOE, J. P. 1987. Techniques in quantitative nematology, p. 223-236 In Experimental techniques in plant disease epidemiology. Kranz, J., and J. Rotem, eds. Springer-Verlag Berlin. Heidelberg-New York.
BARKER, K. R., STARR, J. L., and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.
CABANILLAS, H. E. 1987. Factors influencing the efficacy of Paecilomyces lilacinus in biocontrol of Meloidogyne incognita on tomato. Ph.D. Thesis, NCSU, Raleigh, N.C. 208 p.
KO, M. P. P.-Y, HUANG, J.-S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83: 229-305.
SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

13.018* CRIS0088272

TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology. Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Duchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09

RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.

RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

13.019* CRIS0132029

MORPHOLDGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDDGYNIDAE

TRIANTAPHYLLDU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CARDLINA** 27695.
Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Dbjectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

13.020 0143458

SUPPRESSIDN DF WHITEFRINGED BEETLE BY STEINERNEMATID AND HETERORHABDITID NEMATDDES

KAYA H K; PAINE T D; KLEIN M G; Agricultural Research Service; Agricultural Research Service, Wooster, **OHIO** 44691.
Proj. No.: 3607-24000-003-01T Project Type: INHOUSE
Agency ID: ARS Period: 15 DCT 88 to 14 OCT 89

Dbjectives: To determine the efficacy of various nematode formulations in suppressing whitefringed beetles and other soil-inhabiting insects in an urban environment.

Approach: The objective will be met by treating whitefringed beetles and white grub infested field plots with various nematode formulations and then sampling at intervals to determine the number of surviving larvae and nematodes. Funded by State of California, Department Food and Agriculture Strategic Plan Codes 2.4.05.1.f 50% 2.4.05.1.p 50%.

Progress: 88/10 to 88/12. No significant reduction in population of Cyclocephpala sp. or white fringed beetle larvae was noted one month after a late fall application of the nematodes Steinernema Feltiae and Heterorhabditis sp. (HP 88) in California. Nematodes persisted in the field for over eight weeks.

Publications: 88/10 to 88/12

ND PUBLICATIDNS REPORTED THIS PERIDD.

13.021* CRIS0057100

EVALUATION OF NEMATODE CONTROL PRACTICES IN CRDPS OF ECONOMIC IMPDRTANCE

DRAMAS D; ACDSTA N; ROMAN J; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTD RICD** 00927.
Proj. No.: PR00247 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 28 FEB 93

Dbjectives: To evaluate nematicides, alone and concurrently with cultural, physical and biological selected control practices potentially effective for the control of nematodes affecting crops of economic importance in Puerto Rico.

Approach: Preliminary greenhouse tests will be conducted to select effective nematicides and rates and to evaluate, whenever necessary, selected control practices. The most promising treatments will be tested in the field to determine effects on yield and quality, residue levels and phytotoxicity. Field evaluation will be conducted at different sites and will include nematicide treatments alone and concurrently with cultural, physical and biological selected control practices. The evaluation criteria will be nematode population before, after treatments and at harvesting; commodity yield and quality; cost and earning of the treatments; residues in commodities; persistance in the soil; hazard to humans and toxicity to mammals and plants.

Progress: 87/01 to 87/12. Liquid formulations of fenamiphos, carbofuran and fensulfothion were applied alone and in combination with their granular counterparts (butylfos and carbofuran) as soil treatments in yams. Temik 10G as standard and oxamyl 24L as a check were used for comparison. The trial is underway and data are not available yet. A field experiment was conducted to determine the efficacy of terrazole, thiabendazole and aldicarb, alone and in combinations on the control of fungi and nematodes in plantains. They were not effective against root rot. Significant yeild differences over the control were obtained in nematicide-treated plots, regardless of fungicide treatment. Fruit weight was significantly higher in watermelon plots treated with Paecilomyces lilacinus fungus 2 weeks before planting and in carbofuran-treated plots ad compared to control ones. Significant differences in yield over the control were obtained with applications of carbofuran at 2.24 and 4.48 kg/ha. Three cucumber varieties were evaluated as to root knot nematode resistance at the Isabela Substation. There were no significant differences in yields between cultivars Dasher II and Poinsett 76, but the first one was significantly most resistant than cultivar Geminis 7. Eighteen pumpkin lines were evaluated in the greenhouse as to resistance to M. incognita but only DR-14 and DR-11 were moderately resistant. A survey of 25 commercial farms showed that R. reniformis was the most common nematode associated with papaya.

Publications: 87/01 to 87/12

ECHAVEZ-BADEL, R. 1987. Evaluacion preliminar de la resistencia del pepinillo al nematodo nodulador. Memorias Sociedad Puertorriquena de Ciecias Agricolas, Gurabo, P.R., Nov. 13, p. 21 (Abstr.).

NEGRON, J. and ACOSTA, N. 1987. Studies on host-parasite relationships of Meloidogyne incognita and Coffea arabica cv. Borbon. Nematropica 17(1):71-78.

ORAMAS, D. and ROMAN, J. 1987. Cambios histologicos inducidos en la raiz del platano (Musa acuminata x M. balbisiana, AAB) por 4 especies de nematodos de importancia economica en Puerto Rico.

VICENTE, N., ABREU, E. and MEDINA-GAUD, S. 1987. Chemical control of Meloidogyne incognita, Rotylenchulus reniformis and Anthonomus eugenii in Capsicum annuum and C. frutescens. Nematropica 17(2):163-69.

13.022 0139148
NEMATODE PARASITES OF NURSERY CROPS IN TENNESSEE

HARRISON R E; Agri Sciences; Tennessee State University, Nashville, **TENNESSEE** 37203.

Proj. No.: TENX-9003-12-PS24 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 90

Objectives: To conduct a qualitative and quantitative survey of plant-parasitic nematodes associated with nursery crops in Tennessee, to perform species identifications of all known plant-parasitic nematodes recovered from this survey, and to prepare and publish taxonomic descriptions of all previously unknown plant-parasitic nematodes recovered from this survey. To develop a susceptibility index for rose cultivars to fungal diseases.

Approach: Selected nurseries and nursery crops in various areas of Tennessee will be sampled for the presence of plant-parasitic nematodes. Nematodes will be extracted from samples. All plant-parasitic nematodes will be identified and enumerated. Results will be analyzed statistically to determine correlations between nematode and plant species. Selected rose cultivars will be field-grown, inoculated with known parasitic fungi, and evaluated for relative susceptibility to those fungi.

13.023* CRIS0091504
DISTRIBUTION AND ECOLOGY OF PHYTOPARASITIC NEMATODES IN TENNESSEE

BERNARD E C; Agricultural Exper. Station; University of Tennessee, Knoxville, **TENNESSEE** 37996.

Proj. No.: TEN00719 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To map the distribution of nematodes in Tennessee, and to elucidate factors responsible for those distributions. To study the interactions of nematodes with their hosts and local environments.

Approach: Collection and identification of nematodes will be made from poorly collected areas of the state and from special vegetation and crop types. The known locations of species will be mapped and compared with topographical, soil, and vegetation maps for elucidation of distribution-limiting factors. Factors responsible for nematode density fluctuations will be studied. Such factors include effect of host absence and climate outside of the growing season, effects of soil fungi and various faunal components, and tillage and double-cropping systems. General environmental effects will be determined by the monitoring of nematode populations throughout two or more growing seasons; the results will be useful in determining the proper times for sampling, and for predicting probable densities in the following growing season. Densities of soil fungi antagonistic to nematodes will be

established by a modification of the most-probable-number method.

Progress: 87/01 to 87/12. A survey of plant-parasitic nematodes in virgin areas of the Great Smoky Mountains Natinal Park was continued. An undescribed root-knot nematode (Meloidogyne sp.) was found on hemlock. Perineal patterns of the females are highly reminiscent of M. graminis. Juveniles are large and stocky with a stylet length averaging 16 um. Another nematode was collected with characters similar to Nagelus and Merlinius, but not fitting well into any genus. The nematode fauna of the park's virgin areas is almost completely different from that in agricultural and other disturbed areas. A study was begun on the importance of soil fungi in the regulation of Meloidogyne incognita in commercial tomato fields in east tennessee. Females removed from roots were surface-infested with fungi, mostly Paecilomyces lilacinus, but were rarely infected. Similarly, eggs within egg masses were not parasitized. However, when eggs were embedded in agar on microscope slides and buried for one week, parasitism rates were 15-30%. Females and eggs within egg masses appear to be well-protected from antagonistic fungi, and probably are poor targets for biological control tactics.

Publications: 87/01 to 87/12

BERNARD, E.C. and WITTE, W.T. 1987. Parasitism of woody ornamentals by Meloidogyne hapla. Ann. Appl. Nematol. 1:41-45.

13.024* CRIS0099615

LIFE TABLE STUDIES OF ROOT-KNOT AND CYST NEMATODES

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00822 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 86 to 31 AUG 88

Objectives: To develop basic life tables for root-knot (Meloidogyne spp.) and soybean cyst (Heterodera glycines) nematodes.

Approach: Experiments will be conducted in the greenhouse and in growth chambers to determine stage survival rates, life tables, and fertility tables. Stage survival rates will be calculated according to Ruesink's method. Nematode survivorship will be determined for critical life events: hatch, penetration, establishment, maturity, reproduction. The effects on survivorship of nematode source, plant host, initial nematode density, soil type, and temperature will be determined. Three geographically widely separted isolates of M. incognita and N. glycines will be obtained. Each isolate will be tested on three different hosts. Inoculation and infestation techniques will be compared. Each nematode x host combination will be established in sand, loam, or clay loam. Root systems will be harvested at intervals and assayed for nematode life stages. Sex ratios and natural female nortalities will be determined.

Progress: 87/01 to 87/12. The growth and maturation dynamics of Meloidogyne incognita on different plants were studied in containers. Soil within each container was infested with 1,000 eggs and planted with a squash, sunflower, or soybean seedling. Six, 12, 18, 24 and 30 days later, roots were harvested from each set of plants and stained. Nematodes were categorized as non-swollen juveniles, sausage-stage juveniles, and females. Moost of the juveniles entering roots did so within the first six days, but fewer entered sunflower than soybean and squash. Established, swollen juveniles were most abundant at 12 days on squash and sunflower, but at 18 days on soybean. Most of the juveniles on squash and sunflower had matured to females at 18 days, but on soybean had failed to do so in large numbers until 30 days after planting. Soil counts on non-penetrating juveniles were negligible 18 days after planning. Similar experiments are now being conducted with different initial densities, soil types, and nematode isolates to determine their effects on nematode life histories.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

13.025 CRIS0067074

DISEASES OF ORNAMENTAL PLANTS AND TURFGRASSES

COLBAUGH P F; Research & Extension Center; Texas A&M University, Dallas, **TEXAS** 75252.
Proj. No.: TEX01993 Project Type: HATCH
Agency ID: CSRS Period: 06 DEC 85 to 30 NOV 90

Objectives: To investigate methods of disease control on diseases which limit the production and utilization of turfgrasses and ornamental horticultural crops. Determine the identity, biological nature and pathogenic potential of causal disease agents. Develop preventive disease control measures using cultural, chemical, environmental, and microbiological methods of disease suppression.

Approach: Field and laboratory research efforts will focus on critical problems affecting efficient production and use of ornamental plants and turfgrasses. Research results will be used to develop effective control measures for such diseases employing principles of disease prevention, exclusion or eradication as appropriate to the needs of producers or consumers.

Progress: 87/01 to 87/12. Cedar elm (Ulmus crassifolia Nutt.) is widely used as a landscape tree in North Central Texas. Nurserymen have obtained their trees from native stands growing along streams or on dry limestone hills in northern Texas. While the susceptibility to powdery mildew is a common problem. Field investigations over a two year period determined the severity of powdery mildew on cedar elm trees in Dallas area landscapes. Observations of 247 trees during October 1986, indicated 237 trees had slight to severe symptoms of the disease while 10 trees

showed no visible symptoms. These observations indicate selections of cedar elm can be used to overcome problems of powdery mildew susceptibility. Greenhouse production trials with potted Syngonium podophyllum (white butterfly), Capsicum annum (red pepper), and Chrysanthemum morifolium (surf) were used to determine efficacy and treatment costs for singly applied or combination fungicide treatments during the cropping cycle. Seventy chemical treatments were individually applied to pot plants on two application dates during a 130, 70, or 75 day respective growth period. Measurements of plant growth and visual assessments in response to treatments at the end of the growing cycle indicated that 30% of the treatments were visually superior. Combination fungicide treatments generally gave better growth, higher numbers of healthy leaves, and a better visual appearance than treatments with singly applied fungicides.

Publications: 87/01 to 87/12

PAYNE, I.J. and COLBAUGH, P.F. 1987. Potential hazards involving the use of flowers and leaves in salads. J. Rio Grande Valley Hort. Soc. (In press).

COLBAUGH, P.F. 1987. Influence of single applied and combination fungicide drenches on production efficiency of ornamental greenhouse crops. Proc. Int. Symposium Crop Protection. Gent, Belgium. (In press).

COLBAUGH, P.F. 1987. Turfgrass management practices and their influence on pests. Proc. Am. Chem. Soc., Environ. Chem. Symposium: New Directions in Urban Pest Management: An Environmental Mandate. 19th Nat. Meet. New Orleans, La.

COLBAUGH, P.F. and SIMPSON, B.J. 1987. Powdery mildew resistant Cedar Elms in native tree selections from North Central Texas. Proc. SNA Res. Conf. 32 (In press).

COLBAUGH, P.F., FIELDS, S.L. and SIMPSON, B.J. 1987. Powdery mildew resistance among native populations of cedar elm. (Abstr.). Phytopathology (In press).

COLBAUGH, P.F. 1987. Influence of washing on residual activity of ryegrass seed treatment fungicides. Proc. 58th Int. Golf Course Superintendents Assoc. Phoenix, AZ. 54:16-17.

COLBAUGH, P.F. 1987. Control of turfgrass diseases in the South. Proc. South. Turf Res. Info. Exchg. Group. (Strieg-16) Blacksburg, Virginia. pp. 25-26.

14.001 CRIS0079191
PLANT-PARASITIC NEMATODES IN IOWA

NORTON D C; HINZ P N; EDWARDS J; Plant Pathology Seed & Weed Science; Iowa State University, Ames, **IOWA** 50011.
Proj. No.: IDW02382 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Investigate survival, life cycles, community structure, and biomass of nematodes as they relate to pathogenicity on corn. Test local inbreds and exotic germ plasm from Central and South America for resistance and tolerance to nematodes. Investigate the pathogenicity and ecology of Meloidodera sp. on corn. Study survival of nematodes around corn under snow and no snow cover. Catalog and document the plant-parasitic nematodes in Iowa.

Approach: Nematode numbers and biomass will be taken several times during the growing season in Butler and Story counties. Diversity indexes will be taken to understand better the community structure. Correlations of number and biomass will be correlated with yield. Nematode numbers will be monitored around inbred and exotic corn germ plasm at the Iowa State University Hinds Farm. Resistant lines will be tested further. Meloidodera sp. will be propagated on corn in the greenhouse, and tested for pathogenicity in the field and greenhouse. Pathological anatomy will be studied. Winter survival of nematodes will be measured under snow and no snow conditions. Representative specimens of plant-parasitic nematodes in Iowa will be preserved.

Progress: 87/01 to 87/12. In cooperation with South Dakota State University, four corn inbreds from South Dakota and one from Iowa were field tested against inbred C 123 highly susceptible, for resistance to Pratylenchus spp., most of which was P. hexincisus. Numbers of pratylenchus /g dry root in all five inbreds (B 68, SD 101, SD 102, SD 103, SD 45) were reduced from 25% to 96% of numbers in C 123. All five inbreds, except SD 45 at one date, reduced numbers of nematodes by at least 88%. Identification and cataloging of the plant-parasitic nematodes in Iowa is continuing.

Publications: 87/01 to 87/12

EGUNJOBI, O.A., NORTON, D.C. and MARTINSON, C. 1986. Interaction of Pratylenchus scribneri and Helminthosporium pedicellatum in the etiology of corn root rot. Phytoparasitica 14: 187-95.

NORTON, D.C., CODY, A.M. and GABEL, A.W. 1987. Subanquina calamagrostis and its biology in Calamagrostis spp. in Iowa, Ohio, and Wisconsin. J. Nematol. 19: 260-262.

14.002* CRIS0140375
CHEMICAL AND MOLECULAR BASIS OF HOST-PLANT RESISTANCE TO PESTS

JURD L; WAISS A C JR; DAVIS C; Natural Products Chemistry Research Unit; Western Regional Res Center, Albany, **CALIFORNIA** 94710.
Proj. No.: 5325-24000-004-00D
Project Type: INHDUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: To reduce crop losses from insect, nematode and disease damage via utilization of natural pest resistance systems.

Approach: The chemical basis of pest-plant interactions in the following areas will be studied: (1) Chemical mechanism of tomato and other crop plants which cause resistance to root-knot nematodes and the enhancement of those chemical factors through phytoalexin formation or by the use of plant growth bioregulators. (2) Chemical constituents in corn silk responsible for corn resistance to the corn earworm and development of assay proceduresdesigned to aid plant breeders. (3) The nature and (symbiotic?) origin of hydrolytic enzymes in the saliva of sucking insects which mediate insect probing by depolymerizing plant polysaccharides and the structural features which hinder depolymerization of such polysaccharides.

Progress: 86/01 to 86/12. Several plant species in the genera of Physalis & Petunia exhibit extremely high level of resistance in tomato fruitworm (H. zea). A series of previously unknown steroidal compounds with larval growth inhibiting activity have been isolated from petunia. Others are being isolated from P. ixocarpa (tomatillo) & P. peruviana (cape gooseberry). The possibility of introducing insect & pathogen resistance in tomato & potato through intergeneric protoplast fusion & genetic transfer techniques are being considered. Analysis of tomato roots for tomatine was carried out on a series of tomato plants with varying degrees of resistance to root-knot nematode (M. incognita). Lack of correlation of tomatine content with resistance showed that tomatine is not a key nematode resistance factor although it is of significance in fungal & insect resistance. With the expectation that pectinases in aphid saliva can trigger phytoalexin formation in plants, the tissue culture of aphid susceptible & resistant lines of alfalfa have been established. Treatment of these tissue cultures with elicitors have not given the same phytoalexins as described for alfalfa in the literature. Work on the nature of the phytoalexins produced is in progress. The alkaloid, castanospermine was shown to inhibit enzymes which degrade cell wall polysaccharides. The enzymes are in insects which harbor intercellular prokaryotic bacteria. Work was initiated on genetic engineering studies on insect endosymbiotes.

Publications: 86/01 to 86/12

LEE, M.S., GARAS, N.A. & WAISS, A.C., JR. 1986. HPLC Determination of Sesquiterpenoid Stress Metabolites in Verticillium dahiae infected cotton stele. J. Agric. Food Chem.

490-493.
GARAS, N.A. & WAISS, A.C., JR. 1986. Differential accumulation & distribution of antifungal sesquiterpenoids in cotton stems inoculated with Verticillium dahlin. Phytoph. 76:1011-1017.
GARAS, N.A., WILHEM, S. & SAGEN, J.E. 1986. Relationship of cultivar resistance to distribution of Verticillium dahlia in inoculated cotton plants and to growth of single conidia on excised stem segments. Phytoph. 76: 1005-1010.
DREYER, O.L. 1986. Some structural and stereochemical aspects of coumarin biosynthesis. Recent Adv. in Phytochem. 317-337.
CAMPBELL, B.C. 1986. Host-plant oligosaccharides in the honeydew of Schizahis graminum (Rondani) (Insects, Aphididae). Experientia 42: 151-152.
CAMPBELL, B.C., JONES, K.C. and OREYER, D.L. 1986. Discriminative behavioral responses by aphids to various plant matrix polysaccharides. Entomol. Exp. & Appl. 41: 17-24.

14.003 CRIS0140301
VALIDATION OF WEED AND PESTICIDE MODELS IN IRRIGATED CROPS

SCHWEIZER E E; Sugarbeet Production Research Unit; Agricultural Research Service, Fort Collins, **COLORADO** 80521.
Proj. No.: 0500-21010-002-210
Project Type: INHOUSE
Agency IO: ARS Period: 01 OCT 85 to 30 SEP 89

Objectives: Specify and validate alternative weed management strategies developed by simulation models for their impact on dynamics of weed populations and corn grain yields. Specify and validate pesticide transport models that predict the persistence and movement of herbicides in soils.

Approach: Validate, update, and test weed management models for corn based on weed seeds in soil, weed populations, herbicide and application costs and other crop production data. Soil samples will be analyzed for herbicide residues as a function of herbicide treatment, depth and time. Herbicide residue data will be used to develop and validate pesticide transport models that predict potential groundwater contamination.

Progress: 87/01 to 87/12. Weed management decisions on ninety-six 0.15-acre plots were made by using the bioeconomic corn/weed model. At harvest the fixed prophylactic strategy (most herbicide intensive) plots averaged 3160 weeds/A versus over 116,400 for flexible strategy plots. Grain yields were also 7.8 bu/A higher on fixed plots versus flexible plots which indicates weeds reduced the grain yields in flexible plots. In addition, herbicide use in the flexible plots was reduced 86%, or by 5.2 lb/A, as compared to the fixed plots. Between 1985-1987, flexible weed/corn management strategies specified by the model have reduced surface herbicide load by more than 80% or 14.8 lb/A less herbicide was applied than for the fixed prophylactic strategy. Nematode monitoring in continuous corn also was continued. There was a 50% decline in the sugarbeet cyst nematode, Heterodera schachtii, under corn during 1987. The reproductive index (R), final population/initial population, of root lesion nematode, Pratylenchus neglectus, and ectoparasitic nematodes, Helicotylenchus crenacauda, Merlinius brevidens, and Xiphinema americanum, was similar to those obtained in 1986. P. neglectus showed the greatest 'R' value under corn, followed by M. brevidens, H. crenacauda, and H. americanum.

Publications: 87/01 to 87/12
MICKELSON, R. H. and SCHWEIZER, E. E. 1987. Till-plant systems for reducing runoff under low-pressure, center-pivot irrigation. J. Soil Water Converv. 42:107-111.

14.004 CRIS0096487
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RICH J R; Agricultural Research Center, Live Oak, **FLORIDA** 32060.
Proj. No.: FLA-LIO-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 86/10 to 87/09. Twenty-eight accessions of pigeonpea were obtained from various parts of the world including India, Puerto Rico, Honduras, and Haiti. Greenhouse tests were initiated to determine relative resistance or tolerance of these accessions to Meliodogyne javanica and M. incognita. Individual plants in 150 cc containers were inoculated with 1500 eggs each of M. javanica or M. incognita. Sixty-five days after inoculation, number of egg masses, and root galling was determined. Of the accesions inoculated with M. javanica, 11 of the 28 exhibited no egg mass production or root galling. Twenty-five accessions of the 28 accessions inoculated with M. incognita exhibited no galling or egg mass production. Test data indicated a range of responses from susceptibility to immunity in pigeonpea to the two nematode species. Further tests under field conditions are necessary to confirm these observations.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

14.005 CRIS0134370
EFFICIENT MANAGEMENT OF MULTIPLE-CROPPING, MINIMUM-TILLAGE SYSTEMS

GALLAHER R N; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-AGR-02563 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine multiple-cropping and minimum-tillage system combinations for year-round crop production. Determine soil fertility, chemistry, and physics; cultural aspects of the crops; tillage; pest; and equipment management.

Approach: People in Florida and the southeast are more aware today than ever before that multiple cropping aids in efficient utilization of expensive farming resources. Research studies will be conducted in the following areas: nitrogen and potassium fertilization of a no-tillage rye-soybean, double cropping system, soil fertility, chemical, and physical properties affected by time, location, cropping system, and tillage, etc. Soil will be collected from long-term studies from other locations outside of Florida for comparison with Florida data.

Progress: 88/01 to 88/09. Crop yields are often reduced by nematode infestations. One study was completed that determined the effect of two double cropping systems under two tillage systems on infestation of four nematode species. The vetch/corn cropping system increased the root-knot nematode population by 290% compared to the vetch/grain sorghum double cropping system. In contrast, the vetch/grain sorghum sequence increased the ring nematode population by 65% compared to the vetch/corn cropping system. Conventional and no-tillage treatments were equally infested by nematodes. In another oat/soybean double cropping study total soybean and oat root dry weight was equal for both conventional and no-tillage treatments aftter 10 years of tillage and cropping history. However, no-tillage had more root dry weight (79% of the total) in the upper 10 cm soil layer for soybean and in the upper 5 cm (85% of the total) for oat, as compared to the conventional treatment. This high concentration of roots near the soil surface in no-tillage has implications for management of fertilizer and water for no-tillage double cropping systems.

Publications: 88/01 to 88/09
GALLAHER, R.N., DICKSON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Effect of tillage and multicropping systems on the population dynamics of phytoparasitic nematodes. Anals of Applied Nematology. Accepted for publication.
ORTIZ, R.A. and GALLAHER, R.N. 1988. Evaluacion economica y respuesta del doble cultivo centeno soja a la aplicacion de nitrogeno y potasio en un sistems de labranza cero. Gaceta agronomica (Buenos Aires, Argentina). VIII (No. 43).
CORELLA, J., GALLAHER, R.N. and DICKSON, D.W. 1988. Effect of tillage and vetch-corn versus vetch-grain sorghum succession multicropping systems on population dynamics of phytoparasitic nematodes. Agronomy Dept., IFAS, Univ. of FL.
BUSTILLO, J. and GALLAHER, R. N. 1988. Partitioning of dry matter in fall-grown, no-tillage tropical corn in Florida. Agronomy Dept., IFAS, Univ. of FL, Agronomy Res. Rept. AY 88-04.
BRUNIARD, G.C. 1988. Double-cropped soybean/oat root growth and development affected by tillage. M.S. thesis, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.
ORTIZ, R.A. 1988. Nitrogen and potassium fertilization of a no-tillage rye-soybean double-cropping system. Ph.D. dissertation, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.
VAZQUEZ, L., MYHRE, D.L., GALLAHER, R.N., HANLON, E.A. and PORTIER, K.M. 1988.

14.006 CRIS0096489
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

DICKSON D W; DUNN R A; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with field corn, peanut, soybean, and forage crops grown in Florida, and to design and evaluate management strategies to reduce economic losses on these crops.

Approach: The population dynamics and economic damage levels of Pratylenchus brachyurus and Mel Meloidogyne arenaria on peanut and P. brachyurus and Paratrichodorus sp. on corn will be established. The efficacy of fumigant and nonfumigant nematicides for management of nemas on peanut and corn will be investigated. A crop rotation management scheme will be evaluated for managing M. arenaria on peanut. The population dynamics of nemas in minimum tillage-multicropping systems will be monitored. Host-parasite relationships and economic damage relationships of Meloidogyne spp. to soybeans and of various nematodes including Belonolaimus spp. and Meloidogyne spp. to forage crops will be investigated. In cooperative efforts with plant breeders, germ plasm of forage crops, primarily legumes, will be screened for reactions to Meloidogyne spp.

Progress: 87/10 to 88/09. Three tests were conducted to evaluate the efficacy of fumigant and nonfumigant nematicides for control of Meloidogyne arenaria race 1 on peanut. Methyl bromide, 1, 3-D, methyl isothiocyanate, methyl isothiocyanate mixtures, aldicarb, ethoprop, fenamiphos, and F5145 were evaluated by different methods of application preplant, at plant or at early flowering. Of the 32 treatments evaluated, only seven resulted in

yield increases (P = 0.05) although early season vigor was high in all treated plots. During the latter one-third of the growing season, however, nematode control was not adequate in most treatments resulting in heavy peg, pod, and root infection by M. arenaria. Four populations of Pratylenchus brachyurus were tested in a greenhouse on selected plant species to determine host suitability and usefulness inidentifying physiological races of the nematode. The differential plants were alfalfa, snap bean, citrus, corn, peanut, soybean, and tomato. Fresh shoot or root weights of plants inoculated with all populations were similar to each other and to the uninoculated control in both experiments. The numbers recovered from snap bean were different (P = 0.05) between populations in each test and from soybean in the second test. The differences between populations on snap bean were different in 2 tests. The effect of two cropping and tillage systems on the population dynamics of 4 nematode species was evaluated.

Publications: 87/10 to 88/09

PAYAN, L.A. and DICKSON, D.W. 1988. Host specificity of four populations of Pratylenchus brachyurus. Ann. Appl. Nematol. 2 'in press'.

GALLAHER, R.N., DICKESON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Tillage and multiple cropping systems and population dynamics of phytoparasitic nematodes. Ann. Appl. Nematol. 2 'in press'.

DICKSON, D.W. and HEWLETT, T.E. 1987. Effect of two nonfumigant nematicides on corn grown in two adjacent fields infested with different nematodes. Ann. Appl. Nematol. 1:89-93.

DICKSON, D.W. and MCSORLEY, R. 1987. Standarization of nematicide application rates. Ann. Appl. Nematol. 1:1-5.

DICKSON, D.W. 1984. Cultural control of nematodes. Pp. 40-45. United States Department of Agriculture, Agricultural Research Service. Nematology Workshop. Oct. 15-18.

14.007 CRIS0099914

EFFECTS OF A POLYSPECIFIC NEMATODE COMMUNITY ON SOYBEAN

DICKSON D W; MCSORLEY R; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02598 Project Type: SPECIAL GRANT

Agency ID: CSRS Period: 01 SEP 86 to 30 AUG 88

Objectives: To quantify the effects on soybean of the major nematode genera singly and in various combinations found in polyspecific nematode communities; to determine the population dynamics of the major nematode pathogens on soybean and to determine whether temperature and vertical distribution can influence the population dynamics of individual species sufficiently to cause a separation of the species within the polyspecific community in time and space.

Approach: Sampling of soil and roots from field sites naturally infested with soybean parasitic nemas will begin during the winter and continue on a monthly basis throughout the growing season. The field will be planted with a susceptible soybean cv. Relationships between plant yields and nema densities at various times and depths will be developed by multiple regression analysis. Microplots of single and polyspecific communities of nemas will be analyzed in a 2x2x2 factional replicated 6 times. Main effects will be four nemas, Heterodera glycines, Belonolaimus longicaudatus, Pratylenclus brachyurus and M. incognita.

Progress: 86/09 to 88/08. Two major objectives were accomplished by this project: Quantification of nematode effects on the host: In 1987, soybean yields showed occasional significant (P less than or equal to 0.05) negative correlations between densities of Belonolaimus longicaudatus or Pratylenchus brachyurus measured at various times, but no significant multiple regression equations could be obtained with more than one nematode. More consistent yield relationships with B. longicaudatus were apparent than with P. brachyurus, particularly in terms of stand reduction. For example, the negative correlation of log(2) of preplant B. longicaudatus density with plant stand was significant (r = -0.548, P less than or equal to 0.05), but not with yield in kg/ha (r = -0.394). This suggests that the principal damage of B. longicaudatus to soybean is stand reduction, which can be compensated for by growth of larger plants with increased yield per plant. Determination of population dynamics of the nematode community: In the field plots, no significant (P less than or equal to 0.05) correlations were obtained between the population density of one nematode with that of other species. Similarly, in a 1988 trial in which B. longicaudatus, Meloidogyne incognita, and Heterodera glycines were inoculated alone and in combination into microplots, population growth was usually unaffected by the presence of other species. An unusual exception occurred in the August, 1988 sampling when M.

Publications: 86/09 to 88/08

NO PUBLICATIONS REPORTED THIS PERIOD.

14.008 CRIS0134264

APPLICATION OF POPULATION ECOLOGY IN THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

MCSORLEY R T; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02700 Project Type: HATCH

Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: To assess and improve the efficiency of methods for extracting nematodes from soil. To develop sampling plans for plant-parasitic nematodes in small plots. To develop damage functions for plant-parasitic nematodes on selected agricultural crops. To determine the impact of selected crops and cover crops on dynamics of plant-parasitic

nematodes. To investigate the impact of predators on dynamics of nematodes and their potential for biological control. To investigate the impact of selected nonchemical nematode management techniques, such as solarization, use of resistant or tolerant cultivars, and the cropping systems approach.

Approach: Field plots in sites containing gradients in nematode density will be used to derive damage functions and critical point models of nematode population increase. Taylor's power law will be used in the development of sampling plans.

Progress: 88/06 to 88/10. Work on this project has been initiated within the past several months. Data collected during the 1988 growing season is being used to develop damage functions for the sting nematode Belonolaimus longicaudatus, on corn and soybean. On each crop, relationships between initial and final populations are being developed for B. longicaudatus, Meloidogyne incognita, Pratylenchus branchyurus, and Criconemella spp. Additional field data collected during 1988 are being used to develop sampling plans for these nematodes in small plots. Plant damage functions and nematode population growth functions have been derived for P. brachyurus on peanut in Queenland, Australia, and integrated into a simple management model for testing during the current growing season.

Publications: 88/06 to 88/10

MCSORLEY, R. and O'BRIEN, P.C. 1988. Application of modelling techniques for integrating management options on peanuts. Australian Nematologists' Newsletter 7(2):15-17.

14.009* CRIS0096490

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

OVERMAN A J; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 33508.
Proj. No.: FLA-BRA-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: Investigation of the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops grown in Florida and evaluation of management strategies designed to reduce economic losses due to nematodes attacking agronomic crops.

Approach: In minimum tilled or tilled field plots, nematode populations will be evaluated on various crop sequencing tests. Nematicides and soil-fumigants will be used to determine effect of nematodes and/or soil-borne diseases on crop production potential.

Progress: 87/10 to 88/09. A RCB design of 52 6m x 9.9 m-plots were established in a 10 year Bahia grass pasture in December 1987. Factors tested in the split plot design over a period of 3 years will be fertilizer (336 kg ha-), nematicide carbofuran (2.24 kgai ha-) and seeding of white clover (4.5 kg/ha) cvs. Osceola + Las-1 in all combinations with controls. All treatments were established in December. Furadan was applied only once. Nematode population estimates made during 12 months following treatment indicate that Hemicycliophora is the most abundant genus in the soil followed by Dolichodorus. In general, no striking nematode differences have occurred due to use of carbofuran.

Publications: 87/10 to 88/09

MISLEVY, P., et al. 1988. 'Florona' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).
MISLEVY, P., et al. 1988. 'Florico' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

14.010 CRIS0096488

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

KINLOCH R A; Agr Res Cntr; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 88/01 to 88/12. Winter planting of Cahaba White vetch, Vantage Purple vetch, ryegrass, and wheat were not significantly different from winter fallow in their effects on the soil infestation levels of the rootknot nematode Meloidogyne incognita and on subsequent galling and yields of rootknot susceptible (Hartz 7126) and resistant (Hartz 7110) soybean cultivars. Galling and yield of the susceptible cv over all winter treatments were 2.7 (on a scale of 0-4) and 1228 kg/ha; whereas those of the resistant cv weere 0.1 and 2269 kg/ha. Field studies were initiated to study the influence of summer planted crops (soybean, sorghum, maize, alyceclover, millet, sorghum X sundangrass, lespedeza, hairy indigo, peanut, aeschynomene, and cotton) on the abundance of Meloidogyne arenaria. In evaluations of 34 public and commercial cultivars and breeding lines at a site infested with M. arenaria, yields ranged from 111 kg/ha (DP 497, galling = 3.8 on a scale of 0-4) to 1591 kg/ha (Asgrow 6785, galling = 1.8). Yield of all cultivars (Y) was related to galling (X) by $Y = 2084-475X$, $r = -0.77$ ($P < 0.01$). At a site infested with M. incognita yields ranged from 999 kg/ha (S69-96, galling = 2.6) to 2941

kg/ha (Coker 6847, galling = 0.3). Yield was related to galling as Y = 2691-430X, r = -0.65. At a site infested with the soybean cyst nematode Heterodera glycines (Race 3) yields ranged from 1221 kg/ha (Cobb) to 2793 kg/ha (Coker 6847).

Publications: 88/01 to 88/12

KINLOCH, R.A. 1988. Incidence of nematode trophic groups in a native woodland soil and in adjacent agricultural soil planted to various crops. Proc. Soil Crop Sci. Soc. Florida 47: 249-250.

KINLOCH, R.A. and RODRIQUEZ-KABANA, R. 1989. Rootknot nematode disease. In Compendium of soybean diseases. American Phytopathological Society. (In press).

14.011 CRIS0131246

BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

KINLOCH R A; Agri Res & Education Center; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02624 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: The seasonal population dynamics of root-knot nematodes will be monitored in replicated field plots planted to soybean, sorghum, cotton, and maize. Post-harvest samples of nematodes from the different crops will be examined morphologically to determine distribution changes among the populations.

Progress: 87/10 to 88/09. The relative pathogencities of populations of Meloidogyne incognita and M. arenaria were compared to six soybean cultivars in tests conducted in replicated (X6) field plots and in greenhouse experiments using a pruned soybean technique (single cotyledon). Pruned soybean plants were separately inoculated with 868+-60 incognita juveniles and 1027+-48 arenaria juveniles. After approximately 1 month, three levels of susceptibility were recognized among the cultivars inoculated with incognita: Pioneer 9751, Centennial, and Gordon were the least susceptible, averaging 12 galls per g root. Bedford and Braxton averaged 49 galls, and S69-96 had 75 galls. In the field only S69-96 (gall rating of 2.6) could be separated from the other cultivars which had an average gall rating of 0.6. No levels of susceptibility and could be identified among the cultivars exposed to arenaria in the greenhouse (experimental mean of 190 galls per g root). In the field, however, Gordon (1.3) and Braxton (1.8) were significantly less galled than Bedford (2.4) and Pioneer 9751 (2.5). The most susceptible were Centennial (3.0) and S69-96 with a gall rating of 3.4.

Publications: 87/10 to 88/09

NO PUBLICATIONS REPORTED THIS PERIOD.

14.012 CRIS0096486

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RHOADES H L; Central Fla Res & Ed Center; University of Florida, Sandford, **FLORIDA** 32771.
Proj. No.: FLA-SAN-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of plant nematodes associated with certain agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicides in field studies and evaluate according to yield phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 85/10 to 86/10. The sting nematode, Belonolaimus longicaudatus, and the lance nematode, Hoplolaimus galeatus, were placed alone and in combination on field corn, Zea mays. Both nematodes increased to high populations when alone, but in concomitant populations, the sting nematode reproduced rapidly and built up to a population essentially the same as when alone, whereas the lance nematode increased to only approximately 50% of its population when alone. Injury to the corn was much more severe from the sting nematode. Populations of the sting nematode were high following summer cover crops of sorghum-sudangrass (Sorghum bicolor X S. sudanense), cowpea (Vigna sinensis), and a natural growth of weeds, but were low following cover crops of hairy indigo (Indigofera hirsuta) and jointvetch (Aeschynomeme americana) and soil fallow.

Publications: 85/10 to 86/10

NO PUBLICATIONS REPORTED THIS PERIOD.

14.013* CRIS0140338

NEMATODE AND INTEGRATED PEST MANAGEMENT SYSTEMS FOR THE SOUTHEASTERN COASTAL PLAIN

JOHNSON A W; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 6602-24000-007-00D
Project Type: INHOUSE
Agency ID: ARS Period: 02 AUG 85 to 01 AUG 90

Objectives: Develop integrated pest management systems and models that are effective, energy efficient and economically suitable for managing and predicting populations of plant-parasitic nematodes in intensive vegetable and agronomic cropping systems under irrigation.

Approach: Field tests (using standard and new techniques) will be conducted to determine the effects of cultural practices, crop rotations, cover crops, resistant varieties, tillage methods, irrigation, chemicals and levels of pest management on nematodes, soil-borne fungi, insects, and weeds on intensive horticultural and agronomic crop production systems. Nematode population densities, root-gall indices, seedling diseases, crop response, yield and quality will be recorded. The fate and efficacy of nematicides in soil and groundwater will be determined. The research will be conductedin cooperation with agricultural engineers, agronomists, horticulturists, economists, entomologists, plant pathologists, weed scientists, modelers, and research chemists.

Progress: 87/01 to 87/12. Numbers of root-knot nematode juveniles in intensive cropping systems were <5/150 cc soil in all plots of vegetable crops, except onion and cowpea, following tobacco, and lettuce following sweet corn. The nematode species were 100% Meloidogyne incognita on onion and lettuce, and 70% M. incognita and 30% M. arenaria on cowpea. Numbers of root-knot nematodes were <25/150 cc soil in plots of soybean, cotton, peanut and winter oats prior to planting spring crops. Yields of millet, a potential new crop for the Southeast, were 74% greater in nonirrigated plots treated with fenamiphos and low fertility than yields from similar irrigated treatments. Risk efficient action thresholds have been developed for lesion nematodes on corn. The GLEAMS model (Groundwater Loading Effects of Agricultural Management Systems) was modified to simulate the generation and degradation of pesticide metabolites. GLEAMS-simulated mass of fenamiphos, f. sulfoxide, and f. sulfone in the rhizosphere compared favorably with field data within the variability of observed data. Results from a field test to determine the efficacy of fenamiphos (73.1% in propylene glycol) mixed with Terpine (Unitrol 90) in a 1:1 ratio and fenamiphos (3 SC) applied at 3.3 and 6.6 kg/ha through an irrigation simulator with 0.62 cm of water indicated that lower dosages of fenamiphos and different formulations may provide adequate nematode control, optimum yield, and reduce potential for soil and groundwater pollution.

Publications: 87/01 to 87/12

BURTON, G.W., and JOHNSON, A.W. 1987. Coastal bermudagrass rotations for control of root-knot nematode. J. Nematol. 19:138-140.

JOHNSON, A.W. et al. 1987. The biologic and economic assessment of registered fumigants. USDA Series. 169 pp.

PAYAN, L.A., JOHNSON, A.W., and LITTRELL, R.H. 1987. Effects of nematicides and herbicides alone or combined on Meloidogyne incognita egg hatch and development. Annals of Applied Nematology 1:67-70.

JOHNSON, A.W. et al. 1987. Bibliography of estimated crop losses in the United States due to plant-parasitic nematodes. By: Society of Nematologists Crop Loss Assessment Committee. J. Nematol. 1:6-12.

JOHNSON, A.W. 1987. Nemagation via overhead irrigation. J. Nematol. 19:533. (Abstract).

JOHNSON, A.W., CSINOS, A.S., GLAZE, N.C., and GOLDEN, A.M. 1987. Cochemigation for multiple pest control on tobacco. J. Nematol. 19:533. (Abstract).

JOHNSON, A.W. et al. 1987. Nematicides - A Historical Review. IN J.A. Veech & D.W. Dickson (Eds.) Vistas on Nematology: A Commemoration of the 25th Anniv. of the Soc. of Nematol. pp. 448-454. E.O. Painter Prtg. Co., De Leon Springs, FL.

14.014 CRIS0140217

NEMATODE PATHOLOGY AND MANAGEMENT IN AGRONOMIC CROPS OF THE SOUTHEASTERN COASTAL PLAIN

MINTON N A; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.

Proj. No.: 6602-24000-006-00D
Project Type: INHOUSE
Agency ID: ARS Period: 25 JUN 85 to 25 JUN 90

Objectives: To develop principles and practices of nematode control and management systems for agronomic crops that are economical, energy efficient, and environmentally safe and integrate them with other pest management practices for conventional and conservation tillage systems.

Approach: Maximize nematode control in agronomic crops using resistance rotations, multiple cropping, tillage and chemicals. Determine the interaction of nematodes with other pests in conservation tillage and multiple cropping and integrate with control of other pests to minimize use of chemicals and improve production. Assay soil at different levels in profile to determine rate of nematicide degredation and movement. Utilize laboratory,greenhouse, and field experiments. Obtain population densities of nematodes, fungi and insects, root damage indices, plant vigor ratings, stand counts, plant growth measurements, yield, and product quality. Collect data on peanut for developing peanut production models.

Progress: 87/01 to 87/12. In a double-crop minimum till (MT) experiment, peanut yields were the same following wheat and winter fallow. Moldboard plowed (MBP) plots produced 19% more and % sound mature kernels was greater than in plots planted by the subsoil-plant (SP) method. The nematode Meloidogyne arenaria and the fungus Sclerotium rolfsii were more severe in SP plots than in MBP plots. Also, Temik (3.4 kg ai/ha), the soil fungicide SN84364 (2.2 kg ai/ha), and the combination increased yields 14%, 52% and 81%, respectively. Two formulations of methyl bromide applied without tarp reduced M. arenaria damage and increased peanut yields. The greatest increase of 823 kg/ha occurred for Terr-O-Cide (67 kg ai/ha). Temik (1.7 kg ai/ha) applied postplant to the methyl bromide treated plots increased yields an average of 672 kg/ha. A proprietary nematicide, F5145, reduced M. arenaria damage and increased peanut yields at two rates: 4.9 kg ai/ha, 738 kg/ha and 7.4 kg/ha, 659 kg/ha. Yield differences were not significant when soybean was planted by the SP method in rye

stubble and in fallow soil infested with M. incognita. However, cultivar yields were different and Temik (3.4 kg ai/ha) increased yields 61.5%. Host tests and morphological features of a Meloidogyne incognita isolate were not typical for any previously described M. incognita race. Improved nematode, disease and insect control in MT and conventional tillage will increase profits and/or reduce soil erosion which will benefit the producer and consumer.

Publications: 87/01 to 87/12

MINTON, N.A., GOLDEN, A.M., and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.

MINTON, N.A., LEONARD, R.A., and PARKER, M.B. 1987. Concentration of phenamiphos in the profile of a sandy loam soil as affected by tillage and time. J. Nematol. 19:544. (Abstract).

MINTON, N.A., and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. J. Nematol. 19:38-43.

SUMNER, D.R., and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

14.015 CRIS0090950

NEMATODE PATHOLOGY, RESISTANCE AND CONTROL ON FIELD AND FORAGE CROPS

MINTON N A; Plant Pathology; Georgia Coastal Plain Expt Sta, Tifton, **GEORGIA** 31794.

Proj. No.: GEO-02-0218 Project Type: STATE
Agency ID: SAES Period: 01 NOV 83 to 31 OCT 87

Objectives: Study the pathology caused by nematodes and associated organisms infecting plants and integrate nematode controls that may include resistant varieties, chemicals, and cultural practices into systems for control of other pests consistent with cultural practices that minimize the use of chemicals and energy, maximice soil conservation, and improves per unit production.

Approach: Field experiments involving multiple cropping, resistant varieties, winter legumes, cultural practices, and chemicals will be conducted to develop systems of pest control. Greenhouse experiments to determine the interaction of nematodes with other organisms and to evaluate germplasm for nematode resistance will be conducted.

Progress: 83/11 to 87/10. Pratylenchus safaensis was reported in the U.S. (GA) and Meloidogyne graminicola in GA for the first time. Internal stem discoloration in Cobb soybean was more severe in soil infested with Fusarium oxysporum f. sp. tracheiphilum race 1, Belonolaimus longicaudatus and P. brachyurus than with only the fungus. Nematodes (M. arenaria, P. brachyurus), white mold (Sclerotium rolfsii), and insects of peanuts double-cropped after wheat were managed equally well in minimum-tiled (MT) and moldboard plowed (MB) soil. Yields in 9 experiments were increased an average of 5.5% by a nematicide and 13.3% by a soil fungicide + insecticide and MB plots yielded 7.8% more than MT plots. Numbers of M. incognita in soybean were greater in fallowed than in rye plots, but soybean yields were the same. Soybean yields were greater in MT than in MB plots. Ethylene dibromide reduced numbers of nematodes and increased yields more consistently than did aldicarb and phenamiphos. Crimson clover preceeding irrigated corn planted MT had little effect on M. incognita and Paratrichodorus minor. Phenamiphos at 2.8 kg ai/ha increased corn yields 16%. Hoplolaimus columbus populations were high under crimson clover, hairy vetch, common vetch and rye than in fallowed plots; phenamiphos 2.0 kg ai/ha did not control this nematode in corn planted MT and MB. Soil preparation (MT and MB) in rye stubble had little effect on phenamiphos in the soil profile up to 22 weeks after treatment.

Publications: 83/11 to 87/10

MINTON, N.A. 1986. Impact of conservation tillage on nematode populations. Journal of Nematology 18:135-140.

MINTON, N.A. and CSINOS, A.S. 1986. Effects of row spacings and seeding rates of peanut on nematodes and incidence of southern stem rot. Nematropica 16:167-176.

MINTON, N.A., GOLDEN, A.M. and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.

MINTON, N.A. and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. Journal of Nematology 19:38-43.

SUMNER, D.R. and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

14.016 CRIS0074740

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

MALEK R B; Plant Pathology; 1301 West Gregory Drive, Urbana, **ILLINOIS** 61801.

Proj. No.: ILLU-68-0381 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the variability in nematode-host interactions and determine the relationships among host, abiotic factors, and crop losses caused by plant parasitic nematodes.

Approach: The impact of primary crop species and cultivars on populations of principal nematode parasites under greenhouse and field conditions will be analyzed using mono- and polyspecific nematode communities. Temperature and moisture effects on nematode developmental biology, population development and pathogenicity will be clarified under controlled conditions. Growth and yield responses of primary crops to parasitism by nematodes under field conditions will be correlated with annual growing season weather, soil type, tillage practice and fertility regime.

Progress: 86/10 to 87/09. Post-emergence application of liquid nitrogen to dent corn via simulated fertigation in mid and late June to mitigate early-season damage to plants by the needle nematode Longidorus breviannulatus on sandy soil not treated with a nematicide increased yield 48% over that of corn fertigated once at double-rate in late June in 1986 (data not available at reporting time). Yield of the twice-fertigated, untreated corn was 30% less than that of similarly fertigated corn treated at planting with aldicarb and was equivalent to yield of untreated corn sidedressed with dry nitrogen between rows twice in June. Nitrogen fertigation in early in fertigation in early, mid and late June in 1987 improved stand appearance of nematode-damaged seedlings on untreated soil, but plant response was less than in 1986 beacuse of unusually rapid crop development. Under abnormally high early-season temperature conditions and in contrast to results in the prior year, at-planting treatment with aldicarb provided much abbreviated protection of roots from parasitism by L. breviannulatus and did not effectively suppress nematode population development. Yield comparison data are not yet available.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

14.017 CRIS0095489
THE NEMATODE COMPONENT OF ROOT DISEASE-SOIL INSECT COMPLEXES OF FIELD CROPS

MELTON T A; Plant Pathology; 1301 West Gregory Drive, Urbana, **ILLINOIS** 61801.
Proj. No.: ILLU-68-0363 Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 85 to 30 SEP 88

Objectives: Determine the interrelationships of nematodes and their population dynamics with other soil biological factors, soil types, corn and legume yields, cropping sequences, host genotypes, and economic thresholds and integrate results into crop protection models for corn and legume crops.

Approach: A sequential approach will be used. Various combinations of biotic and abiotic factors first will be tested under controlled conditions of the greenhouse to determine their interrelationships with nematode populations. Significant interactions will be studied further under semicontrolled conditions such as in microplots, where soil biotic factors will remain controlled but natural climate and edaphic factors may influence results. Models will be created or updated to reflect new data. Finally, multiple testing of models will be conducted under field conditions, where all biotic and abiotic factors can interrelate.

Progress: 86/10 to 87/09. Greenhouse studies using F2 isogenic lines of Oh 43 (normal DIMBOA), Oh 43 bx (low DIMBOA), A632, A632 (low DMBOA), and the inbreds C 123 (excellent host), bx/bx (very low DIMBOA), and BX/BX (high DIMBOA) showed differences (P=0.05) in host suitabilities for Pratylenchus scribneri. Low DIMBOA lines were good hosts, whereas normal or high DIMBOA lines were poor hosts. P.scribneri populations on A632 bx and Oh43 bx were more than ten times the size of the A632 and Oh43 populations. Based on orthogonal contrasts these differences were highly significant (P=0.005). Other inbreds are being tested as well as possible mode of actions of DIMBOA. These results provide a basis for more work to determine if OIMBOA is a major mechanism for resistance of corn to P. scribneri. Because DIMBOA concentration is determined by a single gene, resistance could be incorporated into modern hybrids. The mutant bx/bx has been backcrossed to the F3 generation in A632 and Oh43, and to the F2 generation in B37, Mo17, H99, H60, and LH38. These inbreds will be tested to determine the role of OIMBOA as a mechanism for P. scribneri and P. hexincisus.

Publications: 86/10 to 87/09
MELTON, T.A. and SIMCOX, K.O. 1987. Effects of 2,4-Dihydroxy-7-methoxy-2H 1, 4-benzoxazin-3(4h)-one (DIMBOA) in corn lines on reproduction of Pratylenchus hexincisus. J. Nematology 19:543. (Abstr.).

14.018 CRIS0023589
MANAGEMENT AND CHARACTERIZATION OF SELECTED PLANT PARASITIC NEMATODES

FERRIS J M; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IN0058019 Project Type: HATCH
Agency ID: CSRS Period: 13 FEB 84 to 30 SEP 89

Objectives: Assess the influence of biotic and abiotic factors on the development and impact of selected nematode pest species. Study morphological, macromolecular and behavioral differences among disjunct populations of namatode pest species. Evaluate and refine crop-nematode models for predicting yield loss and devising control strategies.

Approach: Collect qualitative and quantitative data on target nematode species, with special emphasis on variability among disjunct populations. Determine yield losses under varied field conditions and cropping procedures, and differential responses of breeding lines to different nematode populations. Incorporate new data in crop-nematode models for use in pest management schemes.

Progress: 86/10 to 87/09. For soybean cyst nematode (SCN) analyses were continued in experiments to assess the relationship between greenhouse susceptibility data for resistance (based on numbers of developing cysts) and field susceptibility tests (based on nematode counts and/or yield data). In the experiments pots containing soybean test lines were buried alongside hill-plot tests of the same lines in 2 field locations. Cyst and egg counts were made at each field site at planting and before harvest (buried pots) to determine development of SCN under field conditions, and yield (hill plots) was recorded for each host line entry. Soil from the same field was used to obtain inoculum to infest greenhouse seedlings of each enttry with eggs and juveniles. Greenhouse cyst

and egg counts were made at 6 weeks. Regression analyses, using means of data from 5 replicates of each field and greenhouse entry, showed correlations between greenhouse cyst and egg counts (R = 1.00), greenhouse and final field egg counts (R = 0.90), yield and final field egg count (R = 0.68) and yield and greenhouse cyst counts (R = 0.62). Additional field tests were conducted at 4 Indiana locations to evaluate 54 soybean lines (25 Group II and 29 Group III) of the 1987 Regional SCN Test for resistance to SCN and yield. The hill-plot tests, 2 in Pulaski, 1 in Tippecanoe, and 1 in Vigo County were planted in grower fields infested with SCN. In addition, soil from each location was used in greenhouse screening tests of the same 54 lines.

Publications: 86/10 to 87/09

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic concepts and methods. Pages 346-353 in J. A. Veech and D. W. Dickson, eds. Vistas on Nematology. 25th anniversary volume of the Society of Nematologists.

FERRIS, V.R. and FERRIS, J.M 1987. Two-dimensional protein patterns in Heterodera avenae. Review Nematologie 9:295-296.

FERRIS, V.R., FERRIS, J.M. and FAGHIHI, J. 1987. Two-dimensional protein patters of strains and pathotypes in Heterodera avenae. J. Nematol. (in press).

FAGHIHI, J., FERRIS, J.M. and FERRIS, V.R. 1987. Relationship between greenhouse and field suscptibility tests of SCN resistant soybean lines. J. Nematol. (in press).

FERRIS, V.R., FERRIS, J.M., MURDOCK, L.L. and FAGHIHI, J. 1987. Two - dimensional protein patterns in Labronema Aporcelaimellus and Eudorylaimus (Nematoda:Dorylaimida). Journal of Nematology (in press).

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic analyses in Dorylaimida using data from 2-D protein patterns. J. Nematol. (in press).

14.019 CRIS0074747

REDUCTION OF CORN LOSSES CAUSED BY NEMATODES IN THE NORTH CENTRAL REGION

FERRIS J M; FERRIS V R; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IND058019-A Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: Determine the interrelationships of nematode species and population size, climatic conditions, edaphic factors and primary rotational crops with corn yield loss caused by plant-parasitic nematodes. Determine the resistance/tolerance potential in corn cultivars to pathogenic nematodes. Expand and refine conr-nematode agroecosystem models for prediction of yield loss.

Approach: Soil and root samples will be collected and processed, and the nematodes recovered identified and counted. Nematicides will be applied to fields with different cropping histories, soil types, nematode population levels and species composition, in replicated plot tests. Yield response will be correlated with nematode and soil insect populations. Various corn cultivars will be examined in greenhouse and field tests to determine what population levles of Pratylenchus hexincisus and P. scribneri each supports. Root systems will be examined to assess the effects of nematodes on their development. A mathematical model developed to simulate the population levels of P. hexincisus in corn roots (PHEX) will be refined through input of data generated by other research associated with this project.

Progress: 86/10 to 87/09. Different rates and formulations of three pesticide compounds were evaluated in field tests to determine their nematicidal activity and effect on corn yields. Of these, two well-established nematicides (carbofuran and terbufos) were applied in a band at planting at rates of 5.6 and 11.2 g a.i./100 m. Each material gave slightly less control of lesion nematode, Pratylenchus hexincisus, at the lower rate, but no differences in yield were detected. In addition, three different formulations of terbufos were applied at 8.4 g a.i./100 m. Use of one of these terbufos formulations gave better nematode control than the others, but the lowest corn yield of any material in the trials. A third experimental compound was highly nematicidal at the highest rate tested (4.48 g a.i./100 m). Yields obtained with this treatment were comparable to those with terbufos and carbofuran. Data acquisition and analysis continued in the Integrated Pest Management study designed to determine the effects on nematode community structure of rotations (corn, soybeans and wheat in 7 combinations) and tillage (conventional moldboard plow in fall with field cultivator before spring planting vs. conservation no-till). Samples were collected at 4 intervals over a 2-year period from experimental plots that have been maintained for this purpose for many years. All nematodes present for each treatment in spring and fall samples of one year have been enumerated at the species level of recognition.

Publications: 86/10 to 87/09

NO PUBLICATIONS REPORTED THIS PERIOD.

14.020 CRIS0023614

NEMATODE COLLECTION AND SYSTEMATICS

FERRIS V R; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IND058020 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To continue to develop testable hypotheses of evolution in time and space for selected groups of free-living and plant parasitic nematodes. To continue development of the Purdue Nematode Collection as a basis for research.

Approach: Obtain data on morphological, behavioral and macromolecular characters for variability in populations and species of selected taxa, reevaluate species limits, and analyze by cladistic methods to develop

phylogenies and to determine whether geographic distributions should be interpreted as the result of vicariance patterns or dispersal. Continue with curatorial care of the Purdue Nematode Collection, and make new collections as necessary to provide experimental materials and for management of pest species.

Progress: 86/10 to 87/09. Considerable progress was made in the comparative analysis of 2-dimensional (2-D) protein patterns in free-living nematode species of the Dorylaimida. Among 6 geographical isolates in the genus Labronema the 2-D protein patterns for 2 isolates from Indiana were found to be nearly identical to the pattern for L. vulvapapillatum from Europe. Morphological and life history data subsequently verified the conspecificity of these three isolates. The pattern for a nominal isolate of L. pacificum from south Florida was very different from the patterns of nominal L. pacificum isolates from Hawaii and Fiji, which had patterns very similar to each other, although a few differences in small spots distinguished the two Pacific isolates from each other. In a Jaccard analysis to obtain a quantitative estimate of the phenetic similarity among the isolates, the European isolate had a similarity coefficient (SC) of 0.932 with the 2 Indiana isolates, which were identical to each other (SC = 1.000). The SC for the 2 Pacific isolates was 0.887. The Florida isolate had a much lower pairwise SC with all the other isolates, ranging from 0.333 to 0.389. The Florida isolate had a lower SC with the Pacific isolates than with the isolates of L. vulvapapillatum, even though it had originally been considered conspecific with the Pacific isolates based on morphological data.

Publications: 86/10 to 87/09

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic concepts and methods. Pages 346-353 in J.A. Veech and D. W., Dickson, eds. Vistas on Nematology. 25th Anniversary volume of the Society of Nematologists.

FERRIS, V.R. and FERRIS, J.M. 1987. Two-dimensional protein patterns in Heterodera avenae. Revue Nematologie 9:295-296.

FERRIS, V.R., FERRIS, J.M. and FAGHIHI, J. 1987. Two-dimensional protein patterns of strains and pathotypes in Heterodera avenae. J. Nematol. (in press).

FAGHIHI, J., FERRIS, J.M. and FERRIS, V.R. 1987. Relationship between greenhouse and field susceptibility tests of SCN resistant soybean lines. J. Nematol. (in press).

FERRIS, V.R., FERRIS, J.M., MURDOCK, L.L. and FAGHIHI, J. 1987. Two - dimensional protein patterns in Labronema, Aporcelaimellus and Eudorylaimus (Nematoda: Dorylaimida). Journal of Nematology (in press).

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic analyses in Dorylaimida using data from 2-D protein patterns. J. Nematol. (in press).

14.021 CRIS0142264
BIOLOGICAL CONTROL OF CORN DISEASES

VAKILI N G; Agricultural Research Service, Ames, **IOWA** 50011.
Proj. No.: 3625-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 20 MAY 87 to 19 MAY 92

Objectives: 1) Reduce infection, suppress disease, and increase yield in corn by combining mycoparasite tolerance with resistance to stalk rot pathogens. 2)Develop highly parasitic strains of mycoparasites. 3) Control infestation by European Corn Borer. 4) Reduce chemical use in seed treatment.

Approach: 1) Corn will be exposed simultaneously to epiphytotic and epimycotic conditions in the field. Genotypes with low frequencies of pathogens and high frequencies of mycoparasites in their pith will be selected. Genotypessupporting high populations of mycoparasites in their leaf sheath will be selected. 2) Mycoparasites with sexual stage will be bred in vitro and screened in dual culture with pathogenic fungi for greater mycopathogenicity. Highly mycopathogenic field isolates will be selected. 3) Corn genotypes will be screened for yield response to the synergistic effect of S. helvellae and B. bassiana. 4) Kernels of inbred lines will be coataed with mycoparasite spores and their yield will be compared with chemically treated kernels.

Progress: 87/05 to 87/12. Application of a spore mixture of Sphaeronaemella helvellae and Beauveria bassiana in the phylloplane of corn during the growing season significantly increased yield, height, and dry stalk weight and reduced the number of feeding holes and the length of tunnels by European corn borer, as compared with application of spores of either fungus or water control. There was a significant interaction between genotype and treatment with these two fungi. The fungus Melanospora damnosa was found to be the teleomorph of the mycopathogenic fungus Gonatobotrys simplex, which is parasitic to Fusarium species that attack cornstalk. Breeding of M. damnosa will provide strains of G. simplex with greater mycopathogenicity to Fusaria. The entomopathogenic fungus B. bassiana was found to be a severe pathogen of nematodes that occupy the rhizosphere of corn.

Publications: 87/05 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

14.022 CRIS0074750
INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

NORTON D C; POLLAK L; Plant Pathology; Iowa State University, Ames, **IOWA** 50011.
Proj. No.: IOWO2285 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the intraspecific variability of plant-parasitic nematodes. Determine the variability in nematode-host

interactions. Determine the relationships among host, abiotic factors, and crop losses caused by plant-parasitic nematodes.

Approach: Evaluate corn inbred and hybrid genotypes for resistance to Pratylenchus hexincisu and P. scribneri in the field and greenhouse. Germ plasm will be obtained from plant breeders and other collections such as the USDA Plant Introduction Stations. Improve for resistance to the above nematodes through crosses of resistant lines including exotic germ plasm such as Zea diploperennis. Investigate patterns of resistance based on DNA sequence analysis.

Progress: 87/01 to 87/12. Zea diploperennis and Z. perennis, in separate previous experiments, have shown promise in having resistance to the lesion nematode, Pratylenchus spp. These cultivars were tested side by side in the field and in the greenhouse in 1987. Both B.diploperennis and Z. perennis were poor host for Pratylenchus hexinisus or P. scribneri compared with Mo17Ht x B73Ht. After 103 days in the greenhouse, numbers of Pratylenchus per gram of dry root were reduced by 82 and 98 percent by Z. perennis and Z. diploperennis, respectively, relative to Mo17Ht x B73Ht. Numbers of Pratylenchus increased 60 fold in Mo17Ht x B73Ht during the experiment. In the field, samples were taken three times after planting and numbers of Pratylenchus per gram of dry root decreased from 76 to 96 and from 67 to 91 percent for Z. diploperennis and Z. perennis, respectively, relative to Mo17Ht x B73Ht, depending on the sampling date. Numbers of Hoplolaimus galeatus per gram of dry root decreased from 46 to 87 percent and 34 to 94 percent for Z. dipleperennis and Z. perennis, respectively, relative to Mo17Ht x B73Ht, depending on the sampling date. Work has been started on screening primitive maize lines for resistance to Pratylenchus spp.

Publications: 87/01 to 87/12

HAKIMI, M.S. 1987. Population changes of plant-parasitic nematodes on maize and soybean cultivars. M.S. Thesis. Iowa State Univ., Ames. 101p.

NDRTDN, D.C. and EDWARDS, J. 1988. Age structure and community diversity of nematodes associated with maize in Iowa sandy soils. J. Nematol. Accepted for publication.

14.023 CRIS0075624

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

TODD T C; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00005 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the intraspecific variability of plant-parasitic nematodes. Determine the relationships among host, abiotic factors, and crop losses caused by plant-parasitic nematodes.

Approach: The morphological variability of Pratylenchus scribneri and Heterodera glycines will be assessed using bright field microscopy. Nematode populations from geographically diverse locations in the North Central Region will be compared. The vertical and temporal distribution of these nematodes will be monitored through intensive sampling of soil profiles in the field and in greenhouse microplots. The effects of soil type, temperature, and host on nematode reproduction and survival and on crop losses will be determined.

Progress: 87/01 to 87/12. The effect of soil nitrogen additions on the damage potential and reproduction of Belonolaimus and Pratylenchus spp. on corn was examined in field microplots containing loamy sand soil. Nitrogen treatments included no addition (initial nitrate plus ammonia level averaged 14 ppm), 2 applications of 10 ppm ammonium nitrte each, or 4 applictions of 10 ppm ammonium nitrate each. Initial Belonolaimus sp. densities were 0, 8, or 16 nematodes/100 cm soil. Numbers of Pratylenchus spp. averaged 7/100 cm soil for all microplots. Samples for nematode analysis were collected from depths of 0-30 and 31-60 cm corn yields. Midseason densities of Belonolaimus and Pratylenchus spp. were significantly greater ($P<0.05$) at the 31-60 cm and the 0-30 cm depth, respectively. A negative linear relationship existed between corn yields and initial soil densities of Belonolaimus sp. ($R = 0.72$). In greenhouse studies, reproduction of Pratylenchus scribneri was compared on 10 corn inbreds. Significant differences in root densities of the nematode were observed for adventitious but not for seminal root systems. Four inbred lines (K41, K301, K303, and SD101) supported final densities below 1000 nematodes/g dry root.

Publications: 87/01 to 87/12

TODD, T.C. 1987. Population dynamics, vertical distribution, and damage potential of a species of Belonolaimus on corn. Journal of Nematology 19:559 (abstr.).

14.024* CRIS0092702

ECOLOGY, PATHOLOGY, AND CONTROL OF NEMATODES ON CULTIVATED AND NATIVE GRASSES

TDDD T C; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00508 Project Type: STATE
Agency ID: SAES Period: 01 JUL 84 to 30 JUN 87

Objectives: To identify phytophagous nematodes associated with cultivated and native grasses. To study pathogenic potential and yield losses due to nematodes. To evaluate control procedures. To investigate nematode interactions with other factors. To determine the importance of nematodes in native prairie grass ecosystems.

Approach: Soil samples will be collected and the nematodes extracted, identified, and counted. Pathogenicity studies will be conducted in the greenhouse and nematicide plots will be established in the field. In

vitro interaction studies will be initiated. Nematode trophic levels will be monitored on selected sites of native tall-grass prairie.

Progress: 83/07 to 87/06. Nematodes identified as having an economic impact on grasses in Kansas include an undescribed species of Belonolaimus (close to B. nortoni) and Pratylenchus scribneri on corn, Tylenchorhynchus martini on sorghum, and Hoplolaimus galeatus galeatus on bentgrass. The estimated damage potential of Belonolaimus sp. was 1-3% of seed-corn weight/nematode. A midsummer soil density of approximately 300 H. galeatus/100 cm was determined to approach the threshold level for visual turf damage. Nematicide efficacy was evaluated in multi-year field tests for selected nematode-host systems. Consistent control of corn nematodes was achieved with at-planting applications of carbofuran and Terbufos at 1.1-2.2 kg/ha. Broadcast application of fenamiphos at 4.6 lb/1000 sq ft reduced populations of turf nematodes and improved turf quality. Observations on the interaction of nematodes and other soil fauna in below ground processes were collected from several tallgrass prairie sites. Nematicide-induced reductions in soil populations of free-living nematodes resulted in a 15% increase in dead roots, presumably due to disturbance of decomposition processes. Primary production of the tallgrass prairie was not affected by changes in nematode densities. In a study using mowing regimes to simulate grazing intensities, a decrease in the percentage of live roots due to mowing was correlated with a decrease in numbers of obligate plant-feeding nematodes and an increase in numbers of bacteria-feeding nematodes.

Publications: 83/07 to 87/06

SEASTEDT, T.R., TODD, T.C., and JAMES, S.W. 1987. Experimental manipulations of arthropod, nematode, and earthworm communities in a North American tallgrass prairie. Pedobiologia 30:9-17.

14.025 CRIS0131304

NEMATODE ECOLOGY AND HOST-PARASITE RELATIONS IN NATURAL AND AGRONOMIC SYSTEMS

TODD T C; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00662 Project Type: STATE
Agency ID: SAES Period: 01 JUL 87 to 30 JUN 90

Objectives: Investigate the interrelationships of nematodes and other soil biota in native tallgrass prairie. Assess the role of nematode interaction w/ other organisms in selected plant diseases in Kansas. Develop nematode management strategies specific for Kansas.

Approach: The effects of experimental manipulation of the biotic communities of native tallgrass prairie soils on nematode population dynamics will be monitored. The involvement of nematodes in disease complexes will be studied through single and multiple species inoculations in field microplots and in the greenhouse. Agronomic management practices will be evaluated for effects on nematode populations and selected for reduction or stabilization of target nematode densities.

Progress: 87/07 to 87/12. Second-year field studies of the interaction of the soybean cyst nematode, Heterodera glycines and the charcoal rot fungus, Macrophomina phaseolina were conducted in northeastern Kansas. Eight SCN-susceptible 4 SCN-resistant soybean genotypes were planted in eight-row plots at two locations. Carbofuran was applied at-planting to 4 rows of each entry. Preliminary results indicate that, for the second year, incidence of charcoal rot was positively correlated with early season SCN infection levels. The soybean entries K1126, K1140, K1143, and C1653 displayed tolerance to the nematode under the conditions of the test. In greenhouse microplot studies, final root densities of H. glycines on the soybean cultivars Williams 82 and Pella were greater in the presence of M. phaseolina when the initial population level of the nematode was below 10,000 eggs. Establishment of H. glycines was evaluated in sandy loam, loam, and silt loam soils. Regression analysis indicated a sigmoidal relationship between nematode infection and initial population with establishment occurring at 100-300 eggs for all 3 soil types. In a study of the effects of fire, mowing, and nutrient amendments on native prairie soil fauna, initial results indicate varied responses by nematode trophic groups. In general, mowing decreased plant-feeding nematode densities but had no effect on bacterial- or fungal-feeding nematode populations while nutrient amendments enhanced total nematode population densities in unburned but not burned plots.

Publications: 87/07 to 87/12

TODD, T.C., PEARSON, C.A.S. and SCHWENK, F.W. 1987. Effect of Heterodera glycines on charcoal rot severity in soybean cultivars resistant and susceptible to soybean cyst nematode. Annals of Applied Nematology 1:35-40.

14.026 CRIS0131303

IDENTIFICATION, BIOLOGY, AND MANAGEMENT OF AGRICULTURALLY IMPORTANT PLANT PARASITIC NEMATODES

MCGAWLEY E C; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02587 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 SEP 91

Objectives: To identify nematode genera, species, and races parasitic on major Louisiana crop plants. To evaluate the influence of other major plant pest groups on nematode population ecology and pathogenicity. To investigate methods useful in reducing nematode-related plant injury.

Approach: Nematode survey, greenhouse host differential testing for nematode race identification, light microscopy of nematode and plant characteristics. Field plot

experiments, microplot research. Laboratory, greenhouse, and field experimentation with natural and synthetic nematicides.

Progress: 87/01 to 87/12. In numerical order, with the frequency of detection indicated in parentheses immediately after, the distribution of the five known races of the Soybean Cyst Nematode (as represented by 162 soil samples collected from the 13 major soybean producing parishes) in Louisiana is as follows: race 1 (7); race 2 (24); race 3 (68); race 4 (30); race 5 (15) and, questionable race (18). Results of greenhouse studies conducted to assess the interaction or lack thereof between the Soybean Cyst Nematode and the Red Crown Rot disease pathogen, Calonectria crotalariae, indicates that the reproduction f each organism is augmented in the presence of the other. Disease effects are additive. Penetrsation of root tissues of cyst nematode resistant plants is significantly increased when it is infected with the fungus. Race 2 of Meloidogyne incognita (Mi-2) is the most common one associated with soybeans in Louisiana. Cultivars which contain resistance to this nematode are available. Cultivars with resistance to Mi-2, but which are severely galled have been observed under field conditions with increasing frequency during the last two years. These cultivars contain both Mi-2 and M. iavanica.

Publications: 87/01 to 87/12

OVERSTREET, C. and MCGAWLEY, E.C. 1987. Influence of Calonectria crotalariae on reproduction of Heterodera glycines on resistant and susceptible soybeans. Journal of Nematology. (In press).

RUSSIN, J.S., LAYTON, M.B., BOETHEL, D.J., MCGAWLEY, E.C. SNOW, J.P. and BERGGREN, G.T. 1987. Interactions of Heterodera glycines with Diaporthe phaseolorum var. caulivora and insect-induced defoliation on soybean.

RUSSIN, J.S., LAYTON, M.B., MCGAWLEY, E.C. BOETHEL, D.J. and SNOW, J.P. 1987. Interactions between soybean looper, stem canker fungus, and soybean cust nematode on soybean. Phytopathology 77: (In Press).

LAYTON, M.B., RUSSIN, J.S., MCGAWLEY, BOETHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Effects of insect-induced defoliation, stem canker disease, and soybean cyst nematode on soybean growth and N(2) fixation.

MCGAWLEY, E.C. and WINCHELL, K.L. 1987. Greenhouse reproduction of single and combined Meloidogyne incognita and M. javanica on soybean. Journal of Nematology 19: (In Press).

14.027 O143918

NATURAL BIOREGULATORS & ANALOGS OF PLANT PARASITIC NEMATODES-NEW ENVIRONMENTALLY SAFE NEMATICIDES

HUETTEL R N; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-065-00D

Project Type: INHOUSE

Agency ID: ARS Period: 01 OCT 89 to 31 MAR 90

Objectives: 1) Determine effects of pheromones and analogs of soybean cyst nematode under greenhouse and field conditions; 2) isolate sex and other pheromones from other bisexual cyst nematodes; 3) develop bioassays to understand pheromones that effect sex change in parthonogenetic nematodes.

Approach: Develop and improve bioassays for detection of pheromones, utilize control release formulations, such as alginated pellets for application of pheromone and analogs to greenhouse and field, use in vitro tissue culture techniques to develop bioassays to test for sex change pheromones.

Progress: 89/10 to 89/12. A patent was completed, approved by the USDA Patent Committee and is in the process of being filed on the soybean cyst nematode sex pheromone and thirteen of its analogs. Greenhouse studies continued on the use of these compounds in alginated pellet formulations to reduce nematode populations with 6 out of 14 analogs completed. The use of these compounds may provide new environmentally safe compounds for commericial use to control soybean cyst nematodes. A study on the affect of root-knot nematodes on scion cultivars of peach propagated in vitro, the greenhouse and in microplots was completed. The results indicated that the response of peaches to nematodes at five weeks in vitro is the same as observed for in vitro propagated peaches grown in the greenhouse and under field conditions. The cultivar "Compact Red Haven" appeared to have the best level of nematode tolerance and will be tested in other locations. In vitro growth studies on Pastueria spp. continued. Monoclonal and polyclonal antibodies were developed in cooperation with Rutgers University. New cultivation techniques look very promising. Field plots were established in 1988 and 1989 in an area infested with soybean cyst nematodes that had been used to evaluate resistant soybean germplasm the previous season. A high degree of population spatial heterogeneity is desirable for developing computer models for promotion of alternative control strategies and this was verified both years.

Publications: 89/10 to 89/12

HUETTEL, R.N. 1989. In vitro screening of soybean cultivars to Radopholus similis and R. citrophilus. Nematropica. In Press. Accepted June, 1989.

HUETTEL, R.N. 1898. Monoxenic culturing of plant parasitic nematodes. IN Plant Parasitic Nematodes. Lab Manual. U. MA Agr. Exp. Sta. Amherst, MA. In Press. Accepted May 1989.

HUETTEL, R.N., REISE, R.W. and HENN, A. 1989. A growers guide to plant parasitic nematodes in Maine. Extension Bulletin, University of Maine. In Press. Accepted June 1989.

HUETTEL, R.N. 1989. Aggregate formation in some Pratylenchus spp. Survival Mechanisms. J. Nematol. 21 566. Abstr.

HUETTEL, R.N. 1989. Response of peach scion cultivars and rootstocks to root-knot nematodes in vitro, in the greenhouse, and in microplots. J. Nematol. 21 566. Abstr.

FRANCL, L.J. and KENWORTHY, W.J. 1989. Heterogeneity in population density of soybean cyst nematodes after evaluation of soybean germplasm. J. Nematol. 21 561. Abstr.

14.028* CRIS0049448
PHEROMONES AND NATURAL BEHAVIOR MODIFYING CHEMICAL COMMUNICATORS OF HELMINTHS OF PLANTS

HUETTEL R N; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, MARYLAND 20705.
Proj. No.: 1275-24000-028-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 84 to 30 SEP 89

Objectives: To study plant parasitic nematode behavior and observe, isolate and identify natural nematode metabolites and behavior modifying compounds (semiochemicals) that may be used to develop new, safer nematode control and bioregulation strategies.

Approach: Develop and improve xenic cultures of plant parasitic nematodes (particu- larly races of soybean cyst, Heterodera glycines; H. schachtii, sugarbeet cyst; H. zeae, corn cyst; Meloidogyne spp; root knot; Rotylenchulus reniformis, reniform; and Pratylenchus spp. lesion nematodes) to observe their development, behavior responses and reaction to pheromones and other semiochemicals. Develop and improve bioassay methods for the detection, isolation, purification and evaluation of specific pheromones and semio- chemicals. Usechromatographic (HPLC, TLC), electrophoretic (SDS, isoelec- tric focusing), and histochemical techniques to isolate and purify new semiochemicals for chemicalcharacterization and to identify their synthesisand receptor sites. Compare similarities and differences of specific pheromones and metabolites of races and species cyst nematodes.

Progress: 87/01 to 87/12. A new in vitro screening technique was developed for determining the pathogenicity of migratory plant parasitic nematodes (PPN) to 15 soybean cultivars. Cultivars known to be resistant to cyst and root-knot nematodes (RN) were highly susceptible to PPN, burrowing nematode. Greenhouse and second year field studies of peach propagated from tissue culture show that the in vitro screening of peach to RN at five weeks gives the same results as two years in the field. The results of both these studies will be of value to breeders and researchers for developing new plant varieties. Digestion profiles of total DNA from three races of soybean cyst nematodes (SCN) by eight restriction enzymes were analyzed on agarose gels. The DNA fragment patterns generated by the three races appeared to be of diagnostic importance. A new technique for rapid DNA isolation was described. These studies aid in understanding the systematics of races of SCN and may lead to production of diagnostic kits for industry. Identification of the sex attractant of SCN has been verified by regrowth of SCN on root-explant in ultrapure water. Purification and identification was completed on GC-MS. The use of pheromones as bioregulators may provide industry with new approaches to nematode management.

Publications: 87/01 to 87/12
HUETTEL, R.N. 1987. In vitro screening of Radopholus citrophilus and R. similis to soybean cultivars. J. Nematol. 18:529. (Abstract)
HUETTEL, R.N., and JAFFE, H. 1987. Attraction and Behavior of Heterodera glycines, the soybean cyst nematode, to some biological and inorganic compounds. Proc. Helminthol. Soc. Wash. 54:122-125.
HUETTEL, R.N., and YAEGASHI, T. 1987. Morphological differences between Radopholus citrophilus and R. similis. Accepted by the J. Nematol. 9-15-87.
REISE, R.W., HUETTEL, R.N., and SAYRE, R.M. 1987. Carrot callus tissue for culture of endoparasitic nematodes. J. Nematol. 19:387-389.
KALINSKI, A., and HUETTEL, R.N. 1987. Repetitive fragments comparison as a diagnostic assay in detection of races of soybean cyst nematode, Heterodera glycines. Accepted by the J. Nematol. 12-20-87.

14.029 CRIS0078756
REDUCTION OF CORN LOSSES CAUSED BY NEMATODES IN THE NORTH CENTRAL REGION

BIRD G W; Entomology; Michigan State University, East Lansing, MICHIGAN 48824.
Proj. No.: MICL01331 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: Determine the interrelationships of nematode species and population size, climatic conditions, edaphic factors and primary rotational crops with corn yield loss caused by plant-parasitic nematodes. Expand and refine corn-nematode agroecosystem models for prediction of yield loss.

Approach: The population dynamics of Longidorus breviannulatus and Pratylenchus penetrans will be monitored under field conditions and evaluated in relation to crop yield, soil temperature, soil texture, crop cultivar and rotation crops. The above parameters and nematicides will be used to manipulate the environment associated with the experimental sites. Data from Objective 1. will be used to validate the existing computer simulation of the population dynamics of Pratylenchus penetrans. A user-oriented model will be developed and evaluated for nematode management decision-making at the production system manager level.

Progress: 87/01 to 87/12. In a joint Michigan State University (NC-147) - Zimbabwe Ministry of Agriculture corn research program, Pratylenchus zeae and Pratylenchus brachyurus the major nematode pests of maize in Zimbabwe communal farms had relative densities of 50.0 and 38.5% and absolute frequencies of 52.6 and 21.9% during the 1985/86 survey, respectively. Maize plants which were infected with > 1,000 Pratylenchus spp. per 10.0 grams of fresh root weight during the survey had a 48% mean yield

reduction. Pratylenchus spp. were identified to be a major problem of maize especially in natural regions II and III with sandy soils and high soil pH. High population densities of Pratylenchus spp. were recovered in maize roots from farms with rainfall range of 600-1,000 mm per year and temperature range of 22.6-30.1 C. Soil nutrients were identified as limiting maize plants infected with high population densities of Pratylenchus spp. Third to fourth stage juveniles and mature females were identified as the main overwintering stages of P. zeae in a field study and these stages constituted 51.9 and 46.3% of the total population of vermiform stages, respectively. The population was aggregateed at depth 0-20 cm but migrated to lower depths during hot and dry months. Clean fallow for one year reduced P. zeae in the soil by 87.5%. Three publications are anticipated for 1988.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

14.030 CRIS0014801
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

MACDONALD D H; Plant Pathology; University of Minnesota, St Paul, **MINNESOTA** 55108.
Proj. No.: MIN-22-042 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs. Determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships. Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Greenhouse rose beds will be sampled to detect changes in populations of Pratylenchus and Paratylenchus spp. Fields infested with Heterodera glycines and planted to nonhost crops will be sampled to correlate the size of the larval population with the probability for soybean crop damage the following season. Microplots will be utilized to determine the pathogenicity of different population densities of the nematode. Sampling to determine the distribution of Pratylenchus penetrans in Minnesota will be continued. Microplot, temperature tank, and field plot techniques will be utilized to compare Minnesota isolates of the nematode and their effects with the characteristics of the nematode as determined in the Northeast.

Progress: 87/01 to 87/12. Unreliable results wee obtained when advanced breeding lines of soybeans were screened for resistance to the soybean cyst nematode, Race 3, by transplanting into and growing seedlings in 10 cm diameter plastic pots filled with an infested sand-soil mix containing 500 infective larvae/pot-plant for 5 weeks. Only 4 to 11 of those larvae (0.8 to 2.2% of the original inoculum) need to infect and develop to the white female stage in order for the seedling to be rejected as being moderately to very susceptible, respectively. The reason or reasons for the low level of infection and/or development of this nematode in some genotypes that proved to be susceptible when inoculated with 2000 larvae, pot-plant is or are unknown. No relationship existed between qualitative characteristics of females that did develop from the low inoculum level of 500 larvae/pot-plant and the reaction that the plan would exhibit when inoculated with 2000 infective larvae. Xiphinema chambersi was reidentified for the first time since 1959 as an inhabitant of Minnesota soils and was postulated to be a virulent pathogen of maize in one field with sandy soil and a high water table. The pathogenicity of Longidorus breviannulatus and other migratory plant nematodes to both a lower vigor and a higher vigor Minnhybrid (5201 and 5303, respectively) growing in a fine sandy loam soil was reduced by planting the hybrids either in a ridge or in furrow compared to normal planting.

Publications: 87/01 to 87/12
SORTLAND, M.E. and MACDONALD, D.H. 1987. Effect of crop and weed species on development of a Minnesota population of Heterodera glycines Race 5 after one to three growing periods. Plant Dis. 71:23-27.

14.031 0137523
INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

MACDONALD D H; Plant Pathology; University of Minnesota, St Paul, **MINNESOTA** 55108.
Proj. No.: MIN-22-040 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the variability in nematode-host interactions. Determine the relationships among host, abiotic factors, and crop losses caused by plant-parasitic nematodes.

Approach: The response of field populations of nematodes to different corn hybrids will be evaluated. Nematode population levels will be determined by sampling plant roots and associated soil. The vertical distribution of nematodes in relation to seasonal changes in soil temperature will be studied by intensive sampling of vertical strata in the soil profile both within and between growing seasons. Reproductive rate, species competition, and stage-specific survival will be related to temperature, soil type, tillage system, and host crop. Reproduction rate will be calculated by dividing final nematode population densities by initial population densities. Species competition will be studied by collecting and comparing population densities of different nematode genera and species at regular intervals throughout the growing season.

Progress: 89/01 to 89/12. Glasshouse evaluations of 488 soybean breeding lines for resistance to Race 3 of the soybean cyst nematode were made during 1989. 208 of these supported more than a minimal level (3 white females/root system) of the nematode and were

eliminated from the SCN resistance breeding program. 44 lines were identified as having marginal resistance to the nematode and may be developed further if their agronomic properties are exceptional. 236 lines (48%) were identified as either having suitable resistance or are worthy of further SCN resistance evaluation. Only 3 species of plant parasitic nematodes (Helicotylenchus pseudorobustus, Paratylenchus projectus, and Pratylenchus hexincisus) were consistently present in a silt loam soil used for a long duration corn-soybean rotation study. Of these, H. pseudorobustus was not abundant (14/116 cm3) at planting and was not affected by the host crop or the number of seasons (up to 5) that a given crop had been grown in monoculture. P. projectus populations, which were largest in plots cropped to 3 or more years of soybeans, declined very sharply to 11, 4.4, 1.6, 0, and 0.6% of the maximum population (502/116 cm3 after 5 years of soybeans) in plots cropped to 1, 2, 3, 4, and 5 years of corn, respectively. Spring P. hexincisus soil populations in the fall-plowed soil were inconsistently detected and quite small (10.5 to 21.5% of populations in soil planted to corn during the previous 5 seasons) following 1-4 crops of corn if that corn followed 5 crops of soybeans.

Publications: 89/01 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

14.032 CRIS0140784
INSECT AND NEMATODE RESISTANCE OF CORN IN THE SOUTH

WILLIAMS W P; DAVIS F M; WINDHAM C L; Agricultural Research Service, Mississippi State, **MISSISSIPPI** 39762.
Proj. No.: 6406-22240-002-000
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 31 MAR 91

Objectives: To develop corn germplasm with resistance to insects (southwestern corn borer and fall armyworm) and nematodes and to improve procedures for evaluating levels of resistance and developing insect and nematode resistant corn germplasm.

Approach: Corn germplasm will be evaluated to locate new sources of insect resistance. Inbred lines and populations with higher levels of resistance and greater agronomic acceptability will be developed while obtaining and utilizing information on insect biology and the inheritance, mechanisms, and causes of resistance. Investigations of mechanisms and causes of resistance will use both whole plants and tissue culture. Field, green- house, and laboratory procedures will be developed for evaluating reaction to various nematodes and evaluations of germplasm for resistance to nematodes initiated.

Progress: 87/01 to 87/12. Several commercial corn hybrids were identified as resistant to Meloidogyne arenaria and M. javanica. Mp307, a corn inbred, was found to be resistant in hybrids. Interactions of Trichoderma koningii and T. harzianum with M. arenaria on corn were investigated; both T. koningii and T. harzianum enhanced plant growth and significantly reduced reproduction of M. arenaria. In comparisons of the response of corn earworm larvae to corn hybrids with resistance to fall armyworm and southwestern corn borer, larvae reared for 1 wk on callus of susceptible hybrids were twice as heavy as those reared on resistant hybrids. In choice tests, twice as many larvae were attracted to callus or leaf extracts of susceptible hybrids as were attracted to resistant hybrids. Weights of southwestern corn borer larvae developing on leaf feeding resistant corn hybrids were 60% less than those from susceptible hybrids when plants were infested at mid-whorl. When plants were infested at anthesis, larval weights did not differ. Development of a plastic multi-cell tray for rearing lepidoptera reduced production costs. Southwestern corn borer moths oviposited 50% as many eggs on whorl stage plants of leaf-feeding resistant hybrids as on susceptible hybrids when given a choice under large cage conditions. The southwestern corn borer female sex pheromone has been identified, field validated, and patented.

Publications: 87/01 to 87/12

DAVIS, F.M., BIRD, T.G., SLODERBECK, P.E., LEWIS, B.E., YOCHIM, R.S., KNUTSON, A.E., NG, S.S., GALLARDO, J.L., PEDROZA, A.S., and MIHM, J.A. 1987. Southwestern corn borer: attractiveness to synthetic pheromone. SW Entomol. 12:57-63.

WILLIAMS, W.P., BUCKLEY, P.M., and DAVIS, F.M. 1987. Tissue culture and its use in investigations of insect resistance of maize. Agric. Ecosystems and Environ. 18:185-190.

WINDHAM, G.L., and WILLIAMS, W.P. 1987. Host suitability of commercial corn hybrids to Meloidogyne arenaria and M. incognita. Ann. of Appl. Nematol. 1:113-16.

KNUTSON, A.E., DAVIS, F.M., BIRD, T.G., and MORRISON, W.P. 1987. Monitoring southwestern corn borer, Diatraea grandiosella Dyar and pheromone-baited traps. Southwestern Entomol. 12:65-71.

NG, S.S., DAVIS, F.M., & WILLIAMS, W.P. 1987. Coordinating supplies of southw. corn borer (Lepidoptera:Pyralidae) and fall armyworm (Lepidoptera:Noctuidae) by manipulating development time using temperature. J. Econ. Entomol. 80:1340-1344.

SANFORD, J.O., WILLIAMS, W.P., HAIRSTON, J.E., and REINSCHMIEDT, L.L. 1987. Doublecropping insect and disease resistant corn and wheat. J. Prod. Agric. 1:60-63.

WILLIAMS, W.P., BUCKLEY, P.M., and DAVIS, F.M. 1987. Feeding response in corn to corn earworm to callus and extracts of corn in the laboratory. J. Environ. Ento.

14.033 CRIS0140544
CHEMISTRY OF HOST PLANT RESISTANCE TO INSECTS, DISEASES, AND NEMATODES

JENKINS J N; HEDIN P A; Cotton Host Plant Resist Res Crop Science Res Lab; Agricultural Research Service, Mississippi State, **MISSISSIPPI** 39762.
Proj. No.: 6406-24000-001-000

Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: To develop more efficient methods for selecting and enhancing cotton, corn,and forage crop germplasm with improved resistance to pests; and to assist in the rearing of quality insects.

Approach: Develop new information on the chemical bases of plant-pest interactions with special emphasis on host plant resistance to major insect, nematode, and disease pests, including boll weevil and Heliothis spp. and assist in the development of information on the chemical and nutritional requirementsto rear high quality insects. Special attention will be given to resist- ance mechanisms which may be common among host crops or important in multiple pest resistance. Allelochemics will be isolated and identified through chemical structure/bioassay. Develop analytical procedures to provide guidance to plant scientists developing resistant germplasm. Elucidate biochemical mechanisms of allelochemicals biosynthesis and action.

Progress: 87/01 to 87/12. Twelve PGR's were applied to ST 213. High rates of gibberelic acid reduced boll size. Gibberellic acid increased yield. Several PGR's reduced yield. Kinetin increased the plants natural resistance to TBW. Previous work showed PIX and chlormequat gave higher protein content in leaves and squares and led to selection of 10 structurally related compounds for testing. Protein analyses are not complete. None affected yield, lint percent or boll size. Seed size was increased by several. Squares and leaves of diverse cotton breeding lines were analyzed for total gossypol and by HPLC for individual terpenoid aldehydes and heliocides. Generally, the HPLC profiles were predictors of TBW resistance. In studies of boll weevil oviposition deterrence, surface glands of resistant lines generally contained more caryophyllene, humulene, and B-bisabolol. Anthers of resistant lines had less gossypol, but more of several long chain waxes. Work to develop a more reliable bioassay is in progress. In continuing work on the whorl juices from corn resistant to FAW, the total solids were found to contain mostly sugars and amino acids. Both the Susceptible and Resistant produced stimulatory amino acid fractions, but the fractions from susceptible lines were more stimulatory. Sugar fractions were minimally stimulatory. Individual amino acids responded differently. Nutritional implications are evident. Results with callus tissue were similar to those with juice.

Publications: 87/01 to 87/12

BIRD, T.G., HEDIN, P.A., and BURKS, M.L. 1987. Feeding deterrent compounds to the boll weevil, Anthonomus grandis Boheman in Rose-of-Sharon, Hibiscus syriacus syriacus L. J. Chem. Ecol. 13:1087-1097.

THOMPSON, A.C., NICOLLIER, G.F., and POPE, D.F. 1987. Indolealkylamines of Desmanthus illinoensis and their growth inhibition activity. J. Agric. and Food Chem. 35:361-365.

PARROTT, W.L., HEDIN, P.A., JENKINS, J.N., and MCCARTY, J.C., Jr. 1987. Feeding and recovery of gossypol and tannin from tobacco budworm larvae. Southwestern Entomol. 12:197-204.

PARROTT, W.L., JENKINS, J.N., and MULROONEY, J.E. 1987. Relationship between gossypol gland density on cotton squares and resistance to tobacco budworm larave. Proc. 1987 Beltwide Cotton Conference. p. 92. (Abstract)

LYDON, J., DUKE, S.O., and HEDIN, P.A. 1987. Coextraction of 5-(hydroxymethyl)2-furaldehyde with phenolic acids in acid-hydrolyzed plant extracts. J. Chromatography 410:474-479.

MILES, D.H., LY, A.M., RANDLE, S.A., HEDIN, P.A., and BURKS, M.L. 1987. Alkaloidal insect antifeedants from Virola calophylla Warb. J. Agric. and Food Chemistry 35:794-797.

14.034 CRIS0090109
REDUCTION OF CORN LOSSES CAUSED BY NEMATODES IN THE NORTH CENTRAL REGION

KERR E D; WYSONG D S; Plant Pathology; University of Nebraska, Scotts Bluff, **NEBRASKA** 69361.
Proj. No.: NEB-44-028 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: Determine the interrelationships of nematode species and population size, climatic conditions, edaphic factors and primary rotational crops with corn yield loss caused by plant-parasitic nematodes.

Approach: Nematicide plots will be used in various phases of a corn-bean-sugar beet rotation. A 3 x 3 factorial will be constructed consisting of 3 nematicides and the 3 crops. The following year the 3 crops will be planted over the nematicidal treatments in each of the three plot areas. The carry-over effects of controlling lesion, and sugar beet and (plus/minus) or root-galling nematodes will be determined. Field surveys and nematicide plots will be used to describe the distribution and yield effects of plant nematodes on corn. Complementary greenhouse studies will be conducted to determine the ability of individual species of nematodes in Nebraska to increase populations on corn and cause root damage or reduced growth or corn plants.

Progress: 87/01 to 87/12. Three nematicides (carbofuran, terbufos, and ethoprop), currently registered for nematode control on corn, were compared for efficacy for control of lesion nematodes, Pratylenchus spp., on corn under three tillage systems in a two-year study. The tillage systems were no-till, roto-till, and conventional till to planting time, all followed by conventional cultivation. The study was conducted during the fifth and sixth years of a tillage system study utilizing a crop rotation of corn-dry bean-sugar beet. The crop was furrow irrigated with surface water. Corn hybrid Pioneer 3732 was used. Carbofuran, terbufos, and ethoprop were applied as a six-inch band incorporation at rates of 454,

227, and 227 g product, respectively, per 305 meter of row at planting. A randomized complete block split-split plot design was used with four replications. Preharvest lesion nematode populations in corn roots were significantly (0.05 level) higher in the nontreated control than in all nematicide treated plots. Nematode populations were significantly greater following terbufos than carbofuran and ethoprop treatments. Nematicide x tillage system interactions were not significant. In field length test strips with no nematicidal treatments there were no significant differences in preharvest nematode populations in corn roots nor in grain yield among thethree tillage systems.

Publications: 87/01 to 87/12
ND PUBLICATIONS REPORTED THIS PERIOD.

14.035* CRIS0132230
CONTROL OF HETERODERA SCHACHTII AND CERCOSPORA BETICOLA ON SUGAR BEET IN THE NEBRASKA PANHANDLE

KERR E D; Panhandle Station; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-44-036 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 JUN 92

Objectives: 1. Determination of the relationship between the cyst and egg counts, respectively, and yield loss associated with the sugar beet cyst nematode for western Nebraska. 2. Development of a sugar beet cercospora leaf spot alert system for western Nebraska. 3. Develop cultural and chemical control measures for diseases of major field and vegetable crops in western Nebraska.

Approach: 1. The number of cysts and eggs of Heterodera schachtii in preplant soil samples will be determined. Paired plots will be established with nematicide treatment and no treatment in areas of a field with a wide range of nematode populations. Root & sugar yield at harvest will be compared to initial cyst & egg populations. Economic threshold levels of nematode populations will be determined for advisory use with growers. 2. Sugar beet Cercospora leaf spot infection will be monitored & compared to periods of leaf wetness, relative humidity, & temperature. Periods favorable for infection will be used to establish fungicide advisories for growers. 3. Fungicides & nematicides will be tested in field plots for efficacy in control of sugar beet nematode & false root-knot nematode on sugar beet, lesion nematode on corn, Rhizoctonia root rot on sugar beet, Botrytis blight on onion, and powdery mildew on sugar beet.

Progress: 87/01 to 87/12. An advisory system for application of fungicides to control Cercospora leaf spot on sugar beet was field tested in western Nebraska in 1986 and 1987. Daily infection values (DIV's) were based on Minnesota/North Dakota systems using duration of relative humidity (RH) >90% and mean air temperature. DIV's were determined in this test using duration of leaf wetness and mean canopy temperature derived from sensors on an automated weather station placed in a sugar beet field with a history of severe leaf spot and also from RH >90% and mean air temperatures derived from a hygrothermograph placed in the same location. DIV's favorable for infection were recorded from July 24-August 3 by leaf wetness and canopy temperatures and only on July 31 and August 8 using RH >90% and air temperatures. A test plot on the same location was used to compare fungicide applications starting with favorable DIV's from the two methods and with first leaf spot symptoms. All fungicide treatments were followed by significantly (0.05 level) less leaf spot than an untreated control but differences among fungicide treatments were not significant. Sugar yield was greater from fungicide treated plots than from control plots but the difference was not significant. Hail injury altered yield level and disease severity. Disease severity was very low, as expected from the weather data, and severity did not increase during periods of unfavorable DIV's.

Publications: 87/01 to 87/12
ND PUBLICATIONS REPORTED THIS PERIOD.

14.036* CRIS0027934
PLANT DISEASE SURVEY AND SPECIAL INVESTIGATIONS

WYSONG D S; WATKINS J E; BODSALIS M G; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-21-001 Project Type: STATE
Agency ID: SAES Period: 01 JUL 66 to 13 MAR 89

Objectives: Monitor plant disease occurrence; determine casal agents of new diseases; deliniate geographic distribution of new and recurring diseases on a periodic basis; make preliminary studies on severity of new or certain recurring diseases; develop judments on feasibility of short-term versus long-term investigations on certain diseases.

Approach: Conduct periodic field examinations for diseases on field crops with particular attention to alfalfa, corn, sorghum, soybeans and wheat; record and maintain records of pathogen identification, disease severity and location, host, and other pertinent data; conduct further study of specific plant diseases collected on survey; study applicability of practical control measure for economically important diseases.

Progress: 87/01 to 87/12. SOYBEANS: A soybean cyst nematode (SCN) survey was conducted in an 8-county area bordering the Missouri River between Richardson County on the south and Burt County on the north. A total of 130 soybean fields were included in the survey, which was initiated in late July and completed in mid-August, 1987. Assays of soil and plant roots collected on survey resulted in the identification of 13 "new" infested fields. The number of fields surveyed by county and the number of confirmed SCN fields (in parentheses) is as follows: Richardson - 20 (4), Nemaha - 20 (2), Otoe - 20 (1), Cass 10 (1), Sarpy - 13 (2), Douglas - 7 (1), Washington - 20 (0), and

Burt - 20 (2). While all of the infested fields are associated with low-lying, river bottomland soils, four of the fields were located in the central or western sections out of the Missouri floodplain region. Three of these fields were in Richardson and one was in Douglas counties. SORGHUM: A sorghum downy mildew survey was conducted in a 35-county area in south central, east central and southeastern Nebraska in order to determine the incidence and severity of the disease in commercial fields. A minimum of four fields were selected at random in each county. The disease was found to occur in 17 of the 35 counties; it was considered severe and, in a few fields, was felt to be yield-limiting in a four-county area including Nuckolls, Thayer, Fillmore and Clay counties.

Publications: 87/01 to 87/12

POWERS, T. and WYSDNG, D.S. 1988. Soybean Cyst Nematode in Nebraska. Crop Prot. Clinic Proc., pgs. 146-148.

JENSEN, S.G., WYSDNG, D.S. and DDUPNIK, B., JR. 1988. Sorghum Downy Mildew, The Disease and its Control. Crop Prot. Clinic Proc., pgs. 123-127.

14.037* CRIS0089157

BIOLOGY, EPIDEMIOLOGY & CONTROL OF VIRUSES & MYCOPLASMA-LIKE ORGANISMS CAUSING DISEASES OF CORN

DAVIS R F; Plant Pathology; Cook College, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11230 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: To identify and characterize viruses, spiroplasmas and MLO s occurring in corn and sorghum in the United States and to develop methodology suitable for virus detection in epidemiological studies. To determine the influence of disease cycle components on epidemics of MDMV and MCDV in the U.S.; to identify these components in newly discovered virus and MLO diseases; and to determine the critical components needed to forcast disease occurrences and intensities and involved in the disease cycles.

Approach: Samples of suspect-diseased plant will be collected and the agents will be identified and characterized. Conjugated ELISA reagents will be purchased or produced after purifying the viruses and obtaining antiserum. Conditions for optimum resultus with ELISA will be determined by standard procedures. Collected samples from late planted corn will be tested during winter by ELISA for four common corn viruses. Weeds will be collected around areas where virus incidence appears high and will be tested by ELISA. To monitor the movement of vechor, leafhoppers will be trapped with yellow sticky traps.

Progress: 87/01 to 87/12. Maize dwarf mosaic virus (MDMV) infected sweet corn plants were detected again this year by indirect enzyme-linked immunosorbent assay (I-ELISA). An overwintering host for strain B of MDMV was not detected. Desiccated corn tissue stored at -10 C for five years was still reactive in I-ELISA.

Publications: 87/01 to 87/12

HUFF, D.E., DAVIS, R.F., and MYERS, R.F. 1987. Longidorus breviannulatus as a vector for brome mosaic virus. Nematology 19:143-145.

14.038* CRIS0083300

INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

CHEN T A; MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11282 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs; determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships; develop and validate predictive crop assessment systems; using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Sampling precision will be tested in field and microplots on several genera of plant parasitic nematodes. Microplots will be established using different soil types and similar nematodes and crops. Electron microscopy, histopathology and nematode culturing procedures will be used to study nematode-virus interactions. Economic thresholds will be modeled by computer to predict yield losses from stress factors and edaphic factors.

Progress: 87/01 to 87/12. Tomato ringspot virus (TomRSV) is transmitted in nature to apples and peaches by the dagger nematode Xiphinema sp. In 1987, we have made the following studies: Development of an improved method to purify Tom RSV: Using a modified buffer and density gradient centrifugation three distinct bands were visible and they were collected in a fractionator equipped with a densitometer scanned at 254 nm. 0.79- 0.97 mg of Tom RSV could be obtained from 100 g of diseased plant tissues.Monoclonal antibodies specific against Tom RSV: Monoclonal antibodies to TomRSV have been developed from hybridoma techniques. Spleenic cells obtained from immunized BALB/c mice were fused with murine myeloma cells (NS-1). Specific antibodies produced from hybridomas were screened against TomRSV. Tom RSV-infected plants and healthy uninfected plants using ELISA. Detection of double stranded RNA from Tom RSV-infected plants: Double-stranded RNA was eluted from 10 cm CF-11 cellulose column in STE buffer (0.1 M NaCC, 0.05 M Tris, 0.001 m EDTA, pH 7.0) only from infected squash plants but not from healthy plants. Electrophoresis in polyacrylamide and agarose gels showed three dsRNA species all of which were resistant to treatments with DNAse and RNAse A.

Publications: 87/01 to 87/12

MOHAN, S. and CHEN, T.A. 1987. An improved procedure for the purification of tomato ringspot virus. N.J. Acad. of Science Bulletin 31:12.
MOHAN, S. and CHEN, T.A. 1987. Detection of double-stranded RNA from squash infected with tomato ringspot virus (TomRSV). Phytopathology 77 (In press).
MOHAN, S. and CHEN, T.A. 1987. Absence of 3'polyadenylation in the RNA of a tomato ringspot virus (TomRSV) isolate. Phytopathology 77 (In press).

14.039 0139915
DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

CHEN T A; MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11285 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes; emphasizing biological and cultural control procedures. Evaluate these tactics and integrate effective procedures into practical nematode management programs which minimize crop losses, environmental contamination, and human health risks.

Approach: Develop efficient and specific detection probes for the diagnosis and identify plant viruses transmitted by nematodev ectors. Biotechnology such as hybridoma techniques and gene probes will be used. Attempt to culture in vitro biological antagonists to nematodes, particularly Pastoria sp. The relationship of the nutritional value of plant roots to nematode production will be investigated. A model system consisting of varieties of Kentucky bluegrass or perennial ryegrass and Tylenchorhynchus maximus will be tested to establish if the nematode's reproduction is affected. Biochemical analyses will then be correlated with reproduction rate.

14.040* CRIS0070699
DAMAGE POTENTIAL AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03546 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Elucidate damage potential of nematodes, especially variable races of Meloidogyne incognita (MI) and M. Arenaria; determine impact of environment on related damage to tobacco and soybean; characterize spatial and temporal populations of nematode; develop and evaluate control tactics; monitor nematode communities species changes; and integrate information on MI on soybean into a simulator.

Approach: Field and microplot experiments will focus on "determinants" involved in nematode-induced crop losses. Evaluate utility of "nematode hazard indices" and economic thresholds. Incorporate data on soybean responses to MI into "CIPM" model. Study biochemical basis of differential virulence and resistance to Meloidogyne spp. on tobacco and mechanisms of nematode suppression of nodulation on soybean. Use findings to improve sampling procedures for advisory purposes. Direct cooperative research toward improving control tactics.

Progress: 87/01 to 87/12. Meloidogyne arenaria (MA) caused more severe damage to peanuts than M. hapla in an interaction study in microplots. Populations of MA differed in their virulence on tobacco. This species, M. hapla, and M. javanica had slight to no effect on the activity of M. incognita (MI) on resistant tobacco. Greenhouse evaluations showed a number of "USDA" tobacco lines to have resistance to one or more of these nematodes. These four root-knot species were found to have differential sensitivity to certain nematicides. Moisture levels affected MI-induced gall development on tobacco as well as leaf growth. Young plants and feeder roots of older Asparagus were found to be susceptible to this nematode. Older roots of this host apparently are resistant to MI. Sphaeronema sasseri and Pratylenchus macrostylus were widespread on Fraser fir and red spruce in the Black Mountains, NC. Both nematode species have low temperature optima.

Publications: 87/01 to 87/12

BARKER, K. R. 1987. Effects of irrigation and cultivar on growth and yield response of tobacco to aldicarb. J. Nematol. 19:511 (Abstr.).
BARKER, K. R., and NOE, J. P. 1987. Establishing and using threshold population levels. In Vistas on Nematology, p.75-81. Veech, J.A., and D.W. Dickson (eds.). Society of Nematologists. E. O. Painter Printing Co., FL.
BARKER, K. R., and NOE, J. P. 1987. Techniques in quantitative nematology, p. 223-236 In Experimental techniques in plant disease epidemiology. Kranz, J., and J. Rotem, eds. Springer-Verlag Berlin. Heidelberg-New York.
BARKER, K. R., STARR, J. L., and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.
CABANILLAS, H. E. 1987. Factors influencing the efficacy of Paecilomyces lilacinus in biocontrol of Meloidogyne incognita on tomato. Ph.D. Thesis, NCSU, Raleigh, N.C. 208 p.
KO, M. P. P.-Y, HUANG, J.-S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83: 229-305.

SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

14.041* CRIS0088272
TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology. Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Ouchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09
RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.
RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

14.042* CRIS0132029
MORPHOLOGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDOGYNIDAE

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

14.043 CRIS0088441
REDUCTION OF CORN LOSSES CAUSED BY NEMATODES IN THE NORTH CENTRAL REGION

RIEDEL R M; Plant Pathology; Ohio State University, Wooster, **OHIO** 44691.
Proj. No.: OH000736 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: Determine the interrelationships of nematode species and population size, climatic conditions, edaphic factors and primary rotational crops with corn yield loss caused by plant-parasitc nematodes.

Approach: Using established crop rotation plots at OARDC cultivated by conventional and no-fill practices, species composition of naturally occurring Pratylenchus populations will be monitored during the 5-year life of the project. Soil samples will be taken pre-plant, mid-June and mid-July. Total plant-parasitic nematode populations will be identified to genus level following extractions by Baermann funnel technique. Composition of Pratylenchus populations will be determined to specific

level. Species and levels of Pratlenchus populations in inoculum provided to corn microplots in field situations for crop loss assessment.

Progress: 87/01 to 87/12. Sweet corn and field corn have been studied for use as rotation crops to control Meloidogyne hapla in vegetable production. They control nematode damage, but they are not economical alternatives to chemical control or control with alternative vegetable crops, such as radish. The influence of field corn on population dynamics of Ohio races of Heterodera glycines is being investigated.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

14.044 CRIS0131089
DISTRIBUTION, ECOLOGY AND PATHOGENICITY OF ROOT-KNOT NEMATODE (MELOIDOGYNE SPP.)

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01225 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 87 to 30 MAR 92

Objectives: Determine the subspecific identity of geographical isolates of Meloidogyne spp. in soybean, cotton, and tobacco; determine environmental and edaphic conditions under which physiologic development is favored; and evaluate various host and nonhost plants for nematode management in potential cropping systems.

Approach: Geographical isolates of Meloidogyne incognita and M. arenaria will be identified using host differential plants, perineal patterns of females, male lip shape, cytology, and esterase enzyme profiles. Soil structure, moisture, and temperature relationships will be assessed for their importance in reproduction and aggressiveness of several M. incognita isolates. Life tables will be constructed after determining activity and developmental thresholds of the isolates. Physical and moisture characteristics of two soils will be studied for their influence on egg hatch, movement, invasion, and reproduction. The host suitability of different cultivars of corn, wheat, and sorghum will be assessed against selected isolates of M. incognita. Mass screening of nematode isolates and plant cultivars will be done in the greenhouse and field. This information will be used to develop an economic model of root-knot nematode management.

Progress: 87/04 to 87/12. Greenhouse and laboratory experiments were performed to determine if an interaction exists between Meloidogyne incognita and Hoplolaimus columbus on Davis soybean. Greenhouse tests were performed with three population levels of M. incognita and H. columbus (0, 15,00, 6,000/1.5-liter pot) separately and in all combinations. Dry root weight (DRT) declined nonlinearly and dry shoot weight (DST) declined linearly with respect to increasing initial populations of M. incognita and H. columbus. When the two nematode species were added to the soil together, the amount of DRT and DST suppression by one species was dependent on the initial level of the concomitant species. The final root population of M. incognita or H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus suppressed M. incognita populations in the soil nonlinearly, but M. incognita had no effect on H. columbus. In other tests, using root explants of M. incognita-susceptible Davis and M. incognita-resistant Centennial, roots parasitized by M. incognita are more attractive to H. columbus than roots of susceptible, and especially M. incognita-resistant soybean ccultivars infected by H. columbus. In susceptible Davis, H. columbus is not only attracted to M. incognita-infected roots but also penetrates these roots more readily than noninfected roots.

Publications: 87/04 to 87/12
GUY, D.W., JR. and LEWIS, S.A. 1987. Selective migration and root penetration by Meloidogyne incognita and Hopololaimus columbus on soybean roots in vitro. J. Nematol. 19:390-392.
GUY, D.W., JR. and LEWIS, S.A. 1987. Interaction between Meloidogyne incognita and Hopolaimus columbus on Davis soybean. J. Nematol. 19:346-351.

14.045 CRIS0093247
SUPPRESSION OF AFLATOXIN AND NEMATODES IN CORN THROUGH CULTURAL PRACTICES

FORTNUM B A; Plant Pathology & Physiology; Pee Dee Res & Educ Center, Florence, **SOUTH CAROLINA** 29501.
Proj. No.: SC01090 Project Type: STATE
Agency ID: SAES Period: 01 JUL 84 to 30 JUN 89

Objectives: Aflatoxin formation in preharvest corn will be evaluated in prolific and non-prolific hybrids. Minimum and conventional tillage systems will be examined for their effects on preharvest aflatoxin formation. Nematode populations will be evaluated in corn grown conventionally and under a minimum tillage cropping system. The role of organic residue on nematode population dynamics will be studied.

Approach: Prolific and non-prolific hybrids will be selected and planted at 10,000 to 25,000 plants/acre to encourage or discourage the prolific tendency. Insect damage and aflatoxin development will be recorded. Aflatoxin development in irrigated and non-irrigated corn grown under minimum tillage will be studied. Insect damage will be recorded and correlated with levels of aflatoxin. Nematode populations will be monitored bimonthly in minimum tillage and conventional tillage corn. Nematode species observed will include Meloidogyne incognita, Belonolaimus longicaudatus and Hoplolaimus columbus. The role of crop organic residues on nematode

popullations will be evaluated in microplots where stover removal can be closely controlled.

Progress: 87/01 to 87/12. The effect of irrigation on aflatoxin production and kernel infection by Aspergillus flavus was evaluated in randomized replicated field plots. Overhead and trickle irrigation equally reduced the level of aflatoxin in ears that were inoculated at silking (by injecting a spore suspension into the silk channel) when compared to the rain-fed control. Inoculation of A. flavus at silking significantly increased aflatoxin production and visible sporulation of the fungus on grain over a non-inoculated control. There was a significant irrigation X inoculation interaction. In non-inoculated plots, overhead irrigation reduced aflatoxin production over plots that were rain-fed; however, trickle irrigation did not reduce the level of aflatoxin. Leaf temperature and plant canopy temperatures were recorded from midsilk through harvest. Data suggest overhead irrigation reduces plant canopy temperatures.

Publications: 87/01 to 87/12

DARRAH, L.L., LILLEHOG, E.B., ZUBER, M.S., SCOTT, G.E., THOMPSON, D., WEST, D.R., WIDSTROM, N.W., and FORTNUM, B.A. 1987. Inheritance of aflatoxin B(1) levels in maize kernels under modified natural inoculation with Aspergillus flavus.

14.046 0138475

INFLUENCES OF MULCHES ON NEMATODES AND DISEASES IN TOMATO AND CORN

FORTNUM B A; Plant Pathology & Physiology; Pee Dee Res & Educ Center, Florence, **SOUTH CAROLINA** 29501.
Proj. No.: SC01323 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 89 to 30 JUN 94

Objectives: Colored plastic mulches, chosen for the quality of light (far-red to red ratio relative to direct sunlight) reflected from their surface, will be evaluated for their effect on root-knot of tomato. Organic mulches and corn hybrids will be assessed for their effect on phytoparasitic nematodes and diseases of corn.

Approach: Colored plastic mulches will be evaluated under field and greenhouse conditions for their effects on root-knot of tomato. Field evaluation will assess plant biomass accumulation, photosynthesis rates, stomatal conductance, and yield. Greenhouse studies will be conducted in simulated planting beds where soil moisture and temperature can be controlled. The effect of organic mulches (corn stover, grain, and legume cover crops) and corn hybrids on phytoparasitic nematodes will be evaluated. In studies utilizing corn stover as the organic mulch the stover will be either left on the soil surface, incorporated with tillage or mechanically removed without soil disturbance. In studies involving grain or legume cover crops the mulches will be incorporated with tillage prior to planting the corn crop.

Progress: 89/07 to 89/12. Colored plastic mulches altered tomato growth under field conditions and impacted losses to root-knot nematodes. Tomato plants grown over white mulch were larger and had more fruit than tomato plants grown over black mulch. Tomato plants grown over white mulch and innoculated with 100,000 Meloidogyne incognita eggs were as large and had as high a yield as tomato plants grown over black mulch without nematodes. The effect of mulch color on nematode development is under study.

Publications: 89/07 to 89/12

NO PUBLICATIONS REPORTED THIS PERIOD.

14.047 CRIS0141411

DEVELOP NEW CONTROL STRATEGIES FOR DIABROTICA SPP. AND CEREAL APHIDS

SUTTER G R; JACKSON J J; BRANSON T F; Agricultural Research Service, Brookings, **SOUTH DAKOTA** 57006.
Proj. No.: 5447-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 01 APR 91

Objectives: 1) Develop mathematical models of population dynamics; 2) identify patho- gens, parasites, and predators of Diabrotica spp. and cereal aphids; 3) develop semiochemical based technology; 4) role of insecticides for management; and 5) model systems for rearing of Diabrotica spp.

Approach: 1. Using system science methodology, construct models of population pro- cesses of Diabrotica spp. and cereal aphids to improve monitoring and pre- diction capabilities for IPM. 2. Evaluate biological control agents of Diabrotica spp. and cereal aphids and host/parasite/environment inter- actions. 3. Semiochemical mixtures will be evaluated in the field for suppression of adult Diabrotica, establishing environmental parameters, application strategies, and efficacy of formulations. 4. Study fate and efficacy of soil insecticides for management of Diabrotica in new crop production systems emphasizing reduced tillage. 5. Methodology and models will be developed to reduce production costs and improve rearing efficacy.

Progress: 87/01 to 87/12. Models describing the population dynamics of the western corn rootworm (WCR) and 5 species of cereal aphids were developed and partially validated in the laboratory and field. These models will be useful in predicting and sampling of pests' stages, determining rates of reproductive development, oviposition, and survival and how host phenology affects pest biology. High densities of immature WCR populations increased pest development time and decreased survival rate. Behavioral responses of semiochemicals were evaluated in mixed populations of WCR and northern corn rootworms (NCR). Responses to pheromone isomers differed by species and they may be of limited value in semiochemical-toxicant baits. A new diet was developed for adult WCR that is equal nutritionally to previous diets but improves

rearing effficiency. Virus-like particles were found in testes of WCR colonies that are believed to cause deformed sperm and significantly reduce egg viability. A cultivation-time application of the entomogenous nematode, Steinernema feltiae, reduced feeding by WCR larvae but less than an insecticide treatment. Poor control was due to lack of persistence of nematodes in the root zone and poor vigor. Eggs were obtained from field-collected Mexican corn rootworms that will be used to determine larval insecticidal responses. Persistence of granular insecticides in alkaline soils in Texas (pH 7.5-8.0) was approximately 1/3 that in mid-western soils.

Publications: 87/01 to 87/12

BRANSON, T.F. 1987. The contribution of prehatch and posthatch development to protandry in the chrysomelid, Diabrotica virgifera virgifera. Entomol. exp. appl. 43:205-208.

BRANSON, T.F. and KRYSAN, J.L. 1987. Laboratory biology of Diabrotica tibialis and a closely related Diabrotica species (Coleoptera: Chrysomelidae). J. Kansas Entomol. Soc. 60:446-450.

BRANSON, T.F., JACKSON, J.J., and SUTTER, G.R. In press. Improved method for rearing Diabrotica virgifera virgifera (Coleoptera: Chrysomelidae) J. Econ. Entomol. Accepted 29 June 1987.

JACKSON, J.J. and ELLIOTT, N.C. In press. Temperature-dependent development of immature stages of the western corn rootworm, Diabrotica virgifera virgifera. Environ. Entomol. Accepted 22 September 1987.

LANCE, D.R. In press. Responses of northern and western corn rootworms to semiochemical attractants in corn fields. J. Chem. Ecol. Accepted 23 June 1987.

ELLIOTT, N.C. and KIECKHEFER, R.W. 1987. Spatial distributions of cereal aphids in winter wheat and spring oats in South Dakota. Environ. Entomol. 16:896-901.

WALGENBACH, D.D., ELLIOTT, N.C. and KIECKHEFER, R.W. In press. Constant and fluctuating temperature effects on developmental rates and life table statistics of the greenbug (Homoptera: Aphididae). J. Econ. Entomol. Accepted 14 Sept 1987.

14.048 CRIS0088818

REDUCTION OF CORN LOSSES CAUSED BY NEMATODES IN THE NORTH CENTRAL REGION

SMOLIK J D; Plant Science; S Dakota State University, Brookings, **SOUTH DAKOTA** 57007.

Proj. No.: SD00282 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 88

Objectives: Determine the interrelationships of nematode species and population size, climatic conditions, edaphic factors and primary rotational crops with corn yield loss caused by plant-parasitic nematodes. Determine the mode of nematode pathogenesis to corn. Determine the resistance/tolerance potential in corn cultivars to pathogenic nematodes.

Approach: The pathogenicity of Tylenchorhynchus nudus on different corn hybrids and at varying inoculum levels will be evaluated in the greenhouse in South Dakota. The interaction of Pratylenchus hexincisus, corn rootworms, and the root rotting fungus Pythium graminicola will be investigated in S. Dak. by addition of the different organisms singly and in combination to field microplots and evaluating growth and yield response. Tolerance level of cultivars both highly susceptible and potentially resistant to Pratylenchus hexincisus and P. scribneri will be determined under field and greenhouse conditions.

Progress: 87/01 to 87/12. Reproduction of Pratylenchus scribneri in an irrigated field was significantly lower in corn inbreds SD101, SD103 and BX/BX than in 84763, bx/bx, C123Ht, and Pioneer hybrid 3709. In a dryland field, reproduction of P. hexincisus was generally low in inbreds SD101, SD102 and SD103. In a tillage X nematicide study, mid-season populations of P. hexincisus were lowest in fall plowed treatments compared to fall chisel and no-till. Carbofuran generally reduced lesion nematode populations, although overall populations were quite low in the study area. Banded applications of Counter provided season-long control of lesion nematodes in irrigated corn. Lesion nematode populations in the irrigated area were lower than those measured in previous years and corn yield increases were not statistically significant.

Publications: 87/01 to 87/12

SMOLIK, J.D. and EVENSON, P.D. 1987. Relationship of yields and Pratylenchus spp. population densities in dryland and irrigated corn. Ann. Appl. Nematol. 1:71-73.

SMOLIK, J.D. and WICKS, Z.W., III. 1987. Reproduction of Pratylenchus Hexincisus and P. scribneri in corn inbreds. Ann. Appl. Nematol. 1:29-31.

SMOLIK, J.D. 1987. Effects of Paratylenchus projectus on growth of sunflower. Plant Disease 71:975-976.

WEAVER, T. and SMOLIK, J. 1987. Soil nematodes of northern Rocky Mountain ecosystems: genera and biomasses. Great Basin Naturalist. 47:473-479.

14.049 CRIS0135585

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

SMOLIK J D; Plant Science; S Dakota State University, Brookings, **SOUTH DAKOTA** 57007.

Proj. No.: SD00078 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the relationship among host, abiotic factors, and crop losses caused by plant-parasitic nematodes. Evaluate the intraspecific variability of plant-parasitic nematodes.

Approach: In cooperation with a Farming Systems Project located at the Northeast Research Station, nematode populations in corn and soybean will be measured in crop rotations

under conventional and reduced tillage. A survey for the soybean cyst nematode initiated in 1986 will be continued in cooperation with S.D. Department of Agriculture. Nematode field trials will be conducted in irrigated and dryland corn in eastern and western S.D. Studies will be conducted in both continuously-cropped and first-year corn. Experiments will be arranged in randomized, complete block designs with four to six replications. Nematode populations will be measured at planting, midseason and harvest, and effects on yield will be determined. Tests will utilize both small scale and field-size plots. Several S.D. inbred corn lines appear to possess a useful degree of resistance to Pratylenchus hexincisus and/or P. scribneri.

14.050* CRIS0137196
SYSTEMATICS, ECOLOGY, AND PATHOGENIC POTENTIAL OF SELECTED PLANT-PARASITIC NEMATODES IN TENNESSEE

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00916 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 89 to 30 SEP 92

Objectives: To identify and describe, when appropriate, plant-parasitic nematodes of potential economic importance, and correlate distribution and abundance of selected nematode species with vegetation and edaphic factors; to determine effects of selected nematode species on host plants.

Approach: Selected crops or plant associations showing stress, or with the potential for being stressed, will be sampled on a field-by-field basis, by plant associations, or by transect. Two major surveys will be conducted: A) on clover pastures and soybean fields to determine the range of a new root-knot nematode species, and B) in all regions of the Great Smoky Mountains National Park, where some species may be contributing to tree declines. Findings will be correlated with edaphic and vegetation factors by means of similarity indices and computer-assisted cluster analysis. Dorylaimid nematodes in the genera Tylencholaimellus and Dorylaimellus will be reared in the greenhouse on corn. Nematodes will be surface-sterilized, then placed on agar plates containing corn callus or excised roots. Nematodes will be observed for feeding and reproduction. An underscribed root-knot nematode parasitic on clover and soybean will be studied to determine host range, pathology on the root system, effects on nodulation, and quantification of damage.

14.051* CRIS0142579
VALIDATION OF WEED AND PESTICIDE MODELS IN IRRIGATED CROPS

GRIFFIN G D; Agricultural Research Service; Agricultural Research Service, Logan, **UTAH** 84322.
Proj. No.: 0500-21010-002-33D
Project Type: INHDUSE
Agency ID: ARS Period: 01 DCT 85 to 30 SEP 88

Objectives: Determine the effect that various regimes of weed control by herbicides have on crop nematodes in continious corn production. Four species of nematode populations will be monitored. Some herbicides may suppress nematodes by direct effect or by eliminating weed hosts. Others may enhancecertain species by altering soil ecology.

Approach: Standardized soil samples will be taken several times during the season from each of the various treatment plots. Total and relative amounts of each species of nematodes will be determined. Larval stages and physiological condition will also be noted as well as level of damage to the host crop.

Progress: 87/01 to 87/12. Data, similar to that obtained in 1986, showed that corn was a nonhost for the endoparasitic sugarbeet cyst nematode, Heterodera schachtii. There was approximately a 50% decline in the soil nematode population under corn culture. However, corn was a fair to good host for the ectoparasitic American dagger nematode, Xiphinema americanum, the ectoparasitic stunt nematode, Merlinius brevidens. The ectoparasitic spiral nematode, Helicotylenchus crenacauda, and the migratory endoparasitic root lesion nematode, Pratylenchus neglectus. The reproductive index (R), final population/initial population, of P. neglectus, H. crenacauda, M. brevidens, and X. americanum, were similar to those obtained in 1986. P. neglectus showed the greatest 'R' value under corn, followed by M. brevidens, H. crenacauda, and X. americanum. As observed in 1986, adverse environmental conditions, such as soil temperature and soil moisture, adversely affected nematode populations, especially the ectoparasitic species.

Publications: 87/01 to 87/12
ND PUBLICATIDNS REPDRTED THIS PERIDD.

14.052* CRIS0097268
DYNAMICS OF THE STRUCTURE AND VERTICAL DISTRIBUTION OF PRATYLENCHUS PENETRANS

MACGUIDWIN A E; Plant Pathology; University of Wisconsin, Madison, **WISCONSIN** 53706.
Proj. No.: WIS02975 Project Type: STATE
Agency ID: SAES Period: 30 SEP 85 to 31 JAN 87

Objectives: Characterize the vertical distribution of P. penetrans associated with potato and corn within and following a growing season. Assess the influence of potato and corn on the age structure of P. penetrans populations in the presence and absence of a host plant. Examine the relation between

vertical distribution, overwinter survival and infectivity of P. penetrans.

Approach: Population census data will be collected at a UW experimental farm facility within and between field growing seasons. Controlled experiments will be conducted in laboratory, growth chamber, and green house facilities. This research will advance our understanding of the biology of P. penetrans and facilitate management strategies for this nematode.

Progress: 87/01 to 87/12. The population dynamics of Pratylenchus associated with potato (cv Russet Burbank) and corn (Wis 4763) was studied in irrigated plots in a Plainfield loamy sand soil. Nematode populations associated with corn were higher at depths above 23 cm than at lower depths. Nematode populations associated with potato were greatest at depths of 15-30 cm. The timing of population increase varied with depth in potato plots, but not in corn plots. Nematodes were recovered from soil and root habitats on all dates and by harvest nematodes were distributed equally between the two habitats. Approximately 10% of the nematodes recovered from soil were located on root surfaces. Populations decreased significantly over the winter, with the greatest mortality occurring between harvest and the onset of soil freezing. All stages overwintered, although the predominant life stage was the fourth-stage juvenile.

Publications: 87/01 to 87/12

MACGUIDWIN, A.E. 1986. Overwinter survival of Pratylenchus spp. - who, what, when, and where. J. Nematol. 18:645 (Abstr.).

MACGUIDWIN, A.E. 1987. Abundance and vertical distribution of Pratylenchus scribneri associated with potato in Wisconsin. Am. Pot. J. 8:448 (Abstr.).

MACGUIDWIN, A.E. Population dynamics of Pratylenchus spp. associated with potato and corn. (In preparation).

MACGUIDWIN, A.E. Vertical distribution of Pratylenchus spp. and Longidorus breviannulatus associated with potato and corn. (In preparation).

15.001* CRIS0096487
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RICH J R; Agricultural Research Center, Live Oak, **FLORIDA** 32060.
Proj. No.: FLA-LIO-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 86/10 to 87/09. Twenty-eight accessions of pigeonpea were obtained from various parts of the world including India, Puerto Rico, Honduras, and Haiti. Greenhouse tests were initiated to determine relative resistance or tolerance of these accessions to Meliodogyne javanica and M. incognita. Individual plants in 150 cc containers were inoculated with 1500 eggs each of M. javanica or M. incognita. Sixty-five days after inoculation, number of egg masses, and root galling was determined. Of the accesions inoculated with M. javanica, 11 of the 28 exhibited no egg mass production or root galling. Twenty-five accessions of the 28 accessions inoculated with M. incognita exhibited no galling or egg mass production. Test data indicated a range of responses from susceptibility to immunity in pigeonpea to the two nematode species. Further tests under field conditions are necessary to confirm these observations.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

15.002* CRIS0134370
EFFICIENT MANAGEMENT OF MULTIPLE-CROPPING, MINIMUM-TILLAGE SYSTEMS

GALLAHER R N; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-AGR-02563 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine multiple-cropping and minimum-tillage system combinations for year-round crop production. Determine soil fertility, chemistry, and physics; cultural aspects of the crops; tillage; pest; and equipment management.

Approach: People in Florida and the southeast are more aware today than ever before that multiple cropping aids in efficient utilization of expensive farming resources. Research studies will be conducted in the following areas: nitrogen and potassium fertilization of a no-tillage rye-soybean, double cropping system, soil fertility, chemical, and physical properties affected by time, location, cropping system, and tillage, etc. Soil will be collected from long-term studies from other locations outside of Florida for comparison with Florida data.

Progress: 88/01 to 88/09. Crop yields are often reduced by nematode infestations. One study was completed that determined the effect of two double cropping systems under two tillage systems on infestation of four nematode species. The vetch/corn cropping system increased the root-knot nematode population by 290% compared to the vetch/grain sorghum double cropping system. In contrast, the vetch/grain sorghum sequence increased the ring nematode population by 65% compared to the vetch/corn cropping system. Conventional and no-tillage treatments were equally infested by nematodes. In another oat/soybean double cropping study total soybean and oat root dry weight was equal for both conventional and no-tillage treatments aftter 10 years of tillage and cropping history. However, no-tillage had more root dry weight (79% of the total) in the upper 10 cm soil layer for soybean and in the upper 5 cm (85% of the total) for oat, as compared to the conventional treatment. This high concentration of roots near the soil surface in no-tillage has implications for management of fertilizer and water for no-tillage double cropping systems.

Publications: 88/01 to 88/09

GALLAHER, R.N., DICKSON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Effect of tillage and multicropping systems on the population dynamics of phytoparasitic nematodes. Anals of Applied Nematology. Accepted for publication.

ORTIZ, R.A. and GALLAHER, R.N. 1988. Evaluacion economica y respuesta del doble cultivo centeno soja a la aplicacion de nitrogeno y potasio en un sistems de labranza cero. Gaceta agronomica (Buenos Aires, Argentina). VIII (No. 43).

CORELLA, J., GALLAHER, R.N. and DICKSON, D.W. 1988. Effect of tillage and vetch-corn versus vetch-grain sorghum succession multicropping systems on population dynamics of phytoparasitic nematodes. Agronomy Dept., IFAS, Univ. of FL.

BUSTILLO, J. and GALLAHER, R. N. 1988. Partitioning of dry matter in fall-grown, no-tillage tropical corn in Florida. Agronomy Dept., IFAS, Univ. of FL, Agronomy Res. Rept. AY 88-04.

BRUNIARD, G.C. 1988. Double-cropped soybean/oat root growth and development affected by tillage. M.S. thesis, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.

ORTIZ, R.A. 1988. Nitrogen and potassium fertilization of a no-tillage rye-soybean double-cropping system. Ph.D. dissertation, Agronomy Dept., IFAS, Univ. of FL,

Gainesville, FL 32611.
VAZQUEZ, L., MYHRE, D.L., GALLAHER, R.N., HANLON, E.A. and PORTIER, K.M. 1988.

15.003* CRIS0096489
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

OICKSON O W; DUNN R A; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02238 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with field corn, peanut, soybean, and forage crops grown in Florida, and to design and evaluate management strategies to reduce economic losses on these crops.

Approach: The population dynamics and economic damage levels of Pratylenchus brachyurus and Mel Meloidogyne arenaria on peanut and P. brachyurus and Paratrichodorus sp. on corn will be established. The efficacy of fumigant and nonfumigant nematicides for management of nemas on peanut and corn will be investigated. A crop rotation management scheme will be evaluated for managing M. arenaria on peanut. The population dynamics of nemas in minimum tillage-multicropping systems will be monitored. Host-parasite relationships and economic damage relationships of Meloidogyne spp. to soybeans and of various nematodes including Belonolaimus spp. and Meloidogyne spp. to forage crops will be investigated. In cooperative efforts with plant breeders, germ plasm of forage crops, primarily legumes, will be screened for reactions to Meloidogyne spp.

Progress: 87/10 to 88/09. Three tests were conducted to evaluate the efficacy of fumigant and nonfumigant nematicides for control of Meloidogyne arenaria race 1 on peanut. Methyl bromide, 1, 3-O, methyl isothiocyanate, methyl isothiocyanate mixtures, aldicarb, ethoprop, fenamiphos, and F5145 were evaluated by different methods of application preplant, at plant or at early flowering. Of the 32 treatments evaluated, only seven resulted in yield increases (P = 0.05) although early season vigor was high in all treated plots. During the latter one-third of the growing season, however, nematode control was not adequate in most treatments resulting in heavy peg, pod, and root infection by M. arenaria. Four populations of Pratylenchus brachyurus were tested in a greenhouse on selected plant species to determine host suitability and usefulness inidentifying physiological races of the nematode. The differential plants were alfalfa, snap bean, citrus, corn, peanut, soybean, and tomato. Fresh shoot or root weights of plants inoculated with all populations were similar to each other and to the uninoculated control in both experiments. The numbers recovered from snap bean were different (P = 0.05) between populations in each test and from soybean in the second test. The differences between populations on snap bean were different in 2 tests. The effect of two cropping and tillage systems on the population dynamics of 4 nematode species was evaluated.

Publications: 87/10 to 88/09
PAYAN, L.A. and OICKSON, D.W. 1988. Host specificity of four populations of Pratylenchus brachyurus. Ann. Appl. Nematol. 2 'in press'.
GALLAHER, R.N., DICKESON, O.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Tillage and multiple cropping systems and population dynamics of phytoparasitic nematodes. Ann. Appl. Nematol. 2 'in press'.
OICKSON, O.W. and HEWLETT, T.E. 1987. Effect of two nonfumigant nematicides on corn grown in two adjacent fields infested with different nematodes. Ann. Appl. Nematol. 1:89-93.
DICKSON, D.W. and MCSORLEY, R. 1987. Standarization of nematicide application rates. Ann. Appl. Nematol. 1:1-5.
OICKSON, O.W. 1984. Cultural control of nematodes. Pp. 40-45. United States Department of Agriculture, Agricultural Research Service. Nematology Workshop. Oct. 15-18.

15.004* CRIS0096490
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

OVERMAN A J; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 33508.
Proj. No.: FLA-BRA-02238 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: Investigation of the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops grown in Florida and evaluation of management strategies designed to reduce economic losses due to nematodes attacking agronomic crops.

Approach: In minimum tilled or tilled field plots, nematode populations will be evaluated on various crop sequencing tests. Nematicides and soil-fumigants will be used to determine effect of nematodes and/or soil-borne diseases on crop production potential.

Progress: 87/10 to 88/09. A RCB design of 52 6m x 9.9 m-plots were established in a 10 year Bahia grass pasture in Oecember 1987. Factors tested in the split plot design over a period of 3 years will be fertilizer (336 kg ha-), nematicide carbofuran (2.24 kgai ha-) and seeding of white clover (4.5 kg/ha) cvs. Osceola + Las-1 in all combinations with controls. All treatments were established in Oecember. Furadan was applied only once. Nematode population estimates made during 12 months following treatment indicate that Hemicycliophora is the most abundant genus in the soil followed by Oolichodorus. In general, no striking nematode differences have occurred due to use of carbofuran.

Publications: 87/10 to 88/09
MISLEVY, P., et al. 1988. 'Florona' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

MISLEVY, P., et al. 1988. 'Florico' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

15.005* CRIS0096488
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

KINLOCH R A; Agr Res Cntr; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 88/01 to 88/12. Winter planting of Cahaba White vetch, Vantage Purple vetch, ryegrass, and wheat were not significantly different from winter fallow in their effects on the soil infestation levels of the rootknot nematode Meloidogyne incognita and on subsequent galling and yields of rootknot susceptible (Hartz 7126) and resistant (Hartz 7110) soybean cultivars. Galling and yield of the susceptible cv over all winter treatments were 2.7 (on a scale of 0-4) and 1228 kg/ha; whereas those of the resistant cv weere 0.1 and 2269 kg/ha. Field studies were initiated to study the influence of summer planted crops (soybean, sorghum, maize, alyceclover, millet, sorghum X sundangrass, lespedeza, hairy indigo, peanut, aeschynomene, and cotton) on the abundance of Meloidogyne arenaria. In evaluations of 34 public and commercial cultivars and breeding lines at a site infested with M. arenaria, yields ranged from 111 kg/ha (DP 497, galling = 3.8 on a scale of 0-4) to 1591 kg/ha (Asgrow 6785, galling = 1.8). Yield of all cultivars (Y) was related to galling (X) by Y = 2084-475X, r = -0.77 ($P < 0.01$). At a site infested with M. incognita yields ranged from 999 kg/ha (S69-96, galling = 2.6) to 2941 kg/ha (Coker 6847, galling = 0.3). Yield was related to galling as Y = 2691-430X, r = -0.65. At a site infested with the soybean cyst nematode Heterodera glycines (Race 3) yields ranged from 1221 kg/ha (Cobb) to 2793 kg/ha (Coker 6847).

Publications: 88/01 to 88/12

KINLOCH, R.A. 1988. Incidence of nematode trophic groups in a native woodland soil and in adjacent agricultural soil planted to various crops. Proc. Soil Crop Sci. Soc. Florida 47: 249-250.

KINLOCH, R.A. and RODRIQUEZ-KABANA, R. 1989. Rootknot nematode disease. In Compendium of soybean diseases. American Phytopathological Society. (In press).

15.006* CRIS0131246
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

KINLOCH R A; Agri Res & Education Center; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02624 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: The seasonal population dynamics of root-knot nematodes will be monitored in replicated field plots planted to soybean, sorghum, cotton, and maize. Post-harvest samples of nematodes from the different crops will be examined morphologically to determine distribution changes among the populations.

Progress: 87/10 to 88/09. The relative pathogencities of populations of Meloidogyne incognita and M. arenaria were compared to six soybean cultivars in tests conducted in replicated (X6) field plots and in greenhouse experiments using a pruned soybean technique (single cotyledon). Pruned soybean plants were separately inoculated with 868+-60 incognita juveniles and 1027+-48 arenaria juveniles. After approximately 1 month, three levels of susceptibility were recognized among the cultivars inoculated with incognita: Pioneer 9751, Centennial, and Gordon were the least susceptible, averaging 12 galls per g root. Bedford and Braxton averaged 49 galls, and S69-96 had 75 galls. In the field only S69-96 (gall rating of 2.6) could be separated from the other cultivars which had an average gall rating of 0.6. No levels of susceptibility and could be identified among the cultivars exposed to arenaria in the greenhouse (experimental mean of 190 galls per g root). In the field, however, Gordon (1.3) and Braxton (1.8) were significantly less galled than Bedford (2.4) and Pioneer 9751 (2.5). The most susceptible were Centennial (3.0) and S69-96 with a gall rating of 3.4.

Publications: 87/10 to 88/09
NO PUBLICATIONS REPORTED THIS PERIOD.

15.007* CRIS0092702
ECOLOGY, PATHOLOGY, AND CONTROL OF NEMATODES ON CULTIVATED AND NATIVE GRASSES

TODD T C; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00508 Project Type: STATE
Agency ID: SAES Period: 01 JUL 84 to 30 JUN 87

Objectives: To identify phytophagous nematodes associated with cultivated and native grasses. To study pathogenic potential and yield losses due to nematodes. To evaluate control procedures. To investigate nematode

interactions with other factors. To determine the importance of nematodes in native prairie grass ecosystems.

Approach: Soil samples will be collected and the nematodes extracted, identified, and counted. Pathogenicity studies will be conducted in the greenhouse and nematicide plots will be established in the field. In vitro interaction studies will be initiated. Nematode trophic levels will be monitored on selected sites of native tall-grass prairie.

Progress: 83/07 to 87/06. Nematodes identified as having an economic impact on grasses in Kansas include an undescribed species of Belonolaimus (close to B. nortoni) and Pratylenchus scribneri on corn, Tylenchorhynchus martini on sorghum, and Hoplolaimus galeatus galeatus on bentgrass. The estimated damage potential of Belonolaimus sp. was 1-3% of seed-corn weight/nematode. A midsummer soil density of approximately 300 H. galeatus/100 cm was determined to approach the threshold level for visual turf damage. Nematicide efficacy was evaluated in multi-year field tests for selected nematode-host systems. Consistent control of corn nematodes was achieved with at-planting applications of carbofuran and Terbufos at 1.1-2.2 kg/ha. Broadcast application of fenamiphos at 4.6 lb/1000 sq ft reduced populations of turf nematodes and improved turf quality. Observations on the interaction of nematodes and other soil fauna in below ground processes were collected from several tallgrass prairie sites. Nematicide-induced reductions in soil populations of free-living nematodes resulted in a 15% increase in dead roots, presumably due to disturbance of decomposition processes. Primary production of the tallgrass prairie was not affected by changes in nematode densities. In a study using mowing regimes to simulate grazing intensities, a decrease in the percentage of live roots due to mowing was correlated with a decrease in numbers of obligate plant-feeding nematodes and an increase in numbers of bacteria-feeding nematodes.

Publications: 83/07 to 87/06

SEASTEDT, T.R., TODD, T.C., and JAMES, S.W. 1987. Experimental manipulations of arthropod, nematode, and earthworm communities in a North American tallgrass prairie. Pedobiologia 30:9-17.

15.008 CRIS0008516
GRAIN SORGHUM INVESTIGATIONS

KANG M; Agronomy; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB01346 Project Type: STATE
Agency ID: SAES Period: 01 JUL 83 to 30 JUN 88

Objectives: To evaluate grain sorghum hybrids for agronomic performance in areas of the state differing in soil and environmental conditions. To assess the range of nematode species which appear to be of economic importance to sorghum culture and to determine the extent and nature of damage to sorghum resulting from nematode infestations. To identify optimum management practices for ratooning sorghum.

Approach: The performance of grain sorghum hybrids will be evaluated at certain branch research stations encompassing the major soil and climatic areas of Louisiana. Commercially available sorghum hybrids will be screened for reaction to nematode species which are found to exist in economically damaging numbers. Soil and root nematode populations will be assessed to determine population levels and to determine differential reaction among the hybrids. The influence of nematode infestations on agronomic performance will be evaluated. Sorghum hybrids of varying maturity planted at different dates during the spring using several planting patterns will be ratoon cropped. Emphasis will be on the identification of optimum cultural practices for high ratoon yields.

Progress: 87/01 to 87/12. The 1987 grain sorghum yield trials were conducted at 7 locations in Louisiana, Alexandria, Baton Rouge, Bossier City, Crowley, Jeanerette, St. Joseph, and Winnsboro. An early maturity and a late maturity test each consisting of 26 hybrids were grown in a randomized complete block design at each location. Data were collected on plant height, heading date, grain yield, test weight, and grain moisture. The tests at Baton Rouge were severely affected by grain mold complex, and those at Winnsboro showed significant lodging due to charcoal rot. All other tests were relatively disease free. Stability variance estimates were calculated for each hybrid tested across locations. This statistic provided an estimate of consistency of performance of each hybrid across locations. Better adapted hybrids possessed high yield and low stability variance. In the early maturity group, the highest yielding location was Alexandria (5220 kg/ha) and the lowest yielding location was Baton Rouge (3560 kg/ha). The Baton Rouge test was adversely affected by grain mold which is caused a number of different fungi. In the late maturity group, Winnsboro was the highest number of different fungi. In the late maturity group, Winnsboro was the highest yielding location (6129 kg/ha and St. Joseph was the lowest yielding location (3702 kg/ha). The overall mean yield for the early group was 3915 lbs/acre and for the late group, it was 4817 kg/ha.

Publications: 87/01 to 87/12

HALL, W., GRIFFIN, J., HALLMARK, W., HARRISON, S.A., MARSHALL, J.G., MILAM, M.R., RABB, J.L., VINES, K. and KANG, M.S. 1987. Performance of Grain Sorghum Hybrids in Louisiana, 1986. LAES Mimeo Series No. 13 pp. 31.

15.009* CRIS0089894
QUANTIFYING THE PARAMETERS OF THE NEMATODE PEST MANAGEMENT DECISION PROCESS

THOMAS S H; Entomology & Plant Pathology; New Mexico State University, Las Cruces, **NEW MEXICO** 88003.
Proj. No.: NM-1-5-27174 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: The effects of edaphic factors on nematode-related crop losses in vegetables, cotton and sorghum will be studied under field conditions. Greenhouse and microplot experiments will be used to rapidly identify germ-plasm-related differences in susceptibility and inoculum influences. The relationship of chemical and cultural control practices to nematode-related crop loss functions will be determined. From this, economic thresholds will be developed for Meloidogyne incognita and Pratylenchus spp. on cotton, sorghum and locally important vegetables.

Progress: 86/10 to 87/12. Acala 1517-E2 cotton and DK 57 grain sorghum yields were reduced 58% and 46% respectively in microplots infested with Meloidogyne incognita host race 3 compared to uninfested plots. Early season plant height was reduced and bloom date delayed in infested sorghum plots, but not in cotton. Aldicarb (1.68 kg a.i./ha) afforded significant control of J2 populations in soil during the first two months of cotton culture, but only 54 liters/ha 1,3-dichloropropene resulted in season-long control in both crops. Net benefits from cotton nematicides (revenue from yield increase associated with nematicide application, less treatment costs) were $274/ha with 1,3-D, $124/ha with fenamiphos (1.85 kg a.i./ha) and $30/ha with aldicarb. Sorghum net benefit was $23/ha with application of 1.12 kg a.i./ha carbofuran, but yield responses with 1,3-D and aldicarb were not cost effective. Residual M. incognita inoculum was 14 x greater in sorghum plots than cotton. Field plot experiments demonstrated a 24% increase in chile pepper yields by increasing depth of placement of 1,3-D from 25 cm (normal placement depth in NM) to 48 cm in sandy loam soils. This results in a $642/ha ($260/acre) increase in net benefit from application. Depth of placement studies were repeated during 1987 and net benefits compared with nonfumigant nematicides. Additional studies were initiated to investigate the interrelationships of phytophagous insects and plant-parasitic nematodes on common host.

Publications: 86/10 to 87/12

ALVAREZ, M.E., SENGUPTA-GOPALAN, C., THOMAS, S., KUEHN, G.D. and KEMP, J.D. 1987. Isolation and characterization of a collagenase that degrades nematode collagen. Proceedings Southwest Consortium on Plant Gentics and Water Resources.

KLUMP, R.S. and THOMAS, S.H. 1987. Comparative resistance of selected Acala 1517 cotton cultivars to Meloidogyne incognita race 3. Annals of Applied Nematology 1:113-115.

THOMAS, S.H. and MURRAY, L. 1987. Yield reductions in grain sorghum associated with injury by Meloidogyne incognita race 3. J. Nematology 19:559. (Abstract).

THOMAS, S.H. 1987. Nematodes in chile: enhancing control by increasing placement depth of Telone II. Proceedings New Mexico Chile Conf.

THOMAS, S.H. and SHANNON, E.L. 1987. Nematode disease losses in New Mexico cotton. Proceedings Beltwide Cotton Production Research Conferences. P. 10.

15.010* CRIS0131089

DISTRIBUTION, ECOLOGY AND PATHOGENICITY OF ROOT-KNOT NEMATODE (MELOIDOGYNE SPP.)

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.

Proj. No.: SC01225 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 87 to 30 MAR 92

Objectives: Determine the subspecific identity of geographical isolates of Meloidogyne spp. in soybean, cotton, and tobacco; determine environmental and edaphic conditions under which physiologic development is favored; and evaluate various host and nonhost plants for nematode management in potential cropping systems.

Approach: Geographical isolates of Meloidogyne incognita and M. arenaria will be identified using host differential plants, perineal patterns of females, male lip shape, cytology, and esterase enzyme profiles. Soil structure, moisture, and temperature relationships will be assessed for their importance in reproduction and aggressiveness of several M. incognita isolates. Life tables will be constructed after determining activity and developmental thresholds of the isolates. Physical and moisture characteristics of two soils will be studied for their influence on egg hatch, movement, invasion, and reproduction. The host suitability of different cultivars of corn, wheat, and sorghum will be assessed against selected isolates of M. incognita. Mass screening of nematode isolates and plant cultivars will be done in the greenhouse and field. This information will be used to develop an economic model of root-knot nematode management.

Progress: 87/04 to 87/12. Greenhouse and laboratory experiments were performed to determine if an interaction exists between Meloidogyne incognita and Hoplolaimus columbus on Davis soybean. Greenhouse tests were performed with three population levels of M. incognita and H. columbus (0, 15,00, 6,000/1.5-liter pot) separately and in all combinations. Dry root weight (DRT) declined nonlinearly and dry shoot weight (DST) declined linearly with respect to increasing initial populations of M. incognita and H. columbus. When the two nematode species were added to the soil together, the amount of DRT and DST suppression by one species was dependent on the initial level of the concomitant species. The final root population of M. incognita or H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus declined linearly with increasing initial population density of the

concomitant species. H. columbus suppressed M. incognita populations in the soil nonlinearly, but M. incognita had no effect on H. columbus. In other tests, using root explants of M. incognita-susceptible Davis and M. incognita-resistant Centennial, roots parasitized by M. incognita are more attractive to H. columbus than roots of susceptible, and especially M. incognita-resistant soybean ccultivars infected by H. columbus. In susceptible Davis, H. columbus is not only attracted to M. incognita-infected roots but also penetrates these roots more readily than noninfected roots.

Publications: 87/04 to 87/12

GUY, D.W., JR. and LEWIS, S.A. 1987. Selective migration and root penetration by Meloidogyne incognita and Hopololaimus columbus on soybean roots in vitro. J. Nematol. 19:390-392.

GUY, D.W., JR. and LEWIS, S.A. 1987. Interaction between Meloidogyne incognita and Hopolaimus columbus on Davis soybean. J. Nematol. 19:346-351.

15.011 CRIS0131690

BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

STARR J L; Plant Pathology & Microbiology; Texas A&M University, College Station, **TEXAS** 77843.

Proj. No.: TEX07121 Project Type: HATCH
Agency ID: CSRS Period: 08 MAY 87 to 30 SEP 91

Objectives: 1. To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: Field microplots will be infested with a population of race 3, race 4, or both of M. incognita. A rotation system of cotton, sorghum, and resistant soybeans will be imposed on each plot. After each growing season several single egg mass isolates from each treatment will be collected and increased on tomato. Resulting populations will be race typed to determine rates of change in race status, if any. In arid regions various skip row planting systems are sued to conserve limited soil moisture. The use of a precision planting system, whereby rows to be planted are always placed over rows fallowed the previous year, will be tested to determine possible benefits in nematode control.

Progress: 87/05 to 87/12. This is a newly established regional project and few studies are yet complete; current project activities are centered on two approaches to management of root-knot nematodes. The first approach is a cultural method whereby skip-row planting systems used to conserve soil moisture in arid regions will be exploited to suppress nematode populations. Long-term (3 yr) experiments have been established to examine the benefit of planting only over rows fallowed the previous year in the skip-row planting system. The other approach to management is the development of root-knot resistant cultivars in crops that are attractive as rotational crops for soybean. Peanut is naturally resistant to soybean cyst nematodes and Meloidogyne javanica and M. incognita. If resistance to M. hapla and M. arenaris can be incorporated into acceptible peanut cultivars, then peanut would be an acceptable rotational crop for soybean. We have begun screening exotic Arachis species germplasm for useful sources of resistance to M. arenaria and M. hapla.

Publications: 87/05 to 87/12

WIGGERS, R., STARR, J.L. and PRICE, H.J. 1987. DNA content of Meloidogyne - induced giant cell nuclei. J. Nematol. 19:562 (Abstr.).

WHEELER, T.A. and STARR, J.L. 1988. Incidence and economic importance of plant-parasitic nematodes on peanuts in Texas. Plant Science:In press.

17.001* CRIS0134370
EFFICIENT MANAGEMENT OF MULTIPLE-CROPPING, MINIMUM-TILLAGE SYSTEMS

GALLAHER R N; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-AGR-02563 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine multiple-cropping and minimum-tillage system combinations for year-round crop production. Determine soil fertility, chemistry, and physics; cultural aspects of the crops; tillage; pest; and equipment management.

Approach: People in Florida and the southeast are more aware today than ever before that multiple cropping aids in efficient utilization of expensive farming resources. Research studies will be conducted in the following areas: nitrogen and potassium fertilization of a no-tillage rye-soybean, double cropping system, soil fertility, chemical, and physical properties affected by time, location, cropping system, and tillage, etc. Soil will be collected from long-term studies from other locations outside of Florida for comparison with Florida data.

Progress: 88/01 to 88/09. Crop yields are often reduced by nematode infestations. One study was completed that determined the effect of two double cropping systems under two tillage systems on infestation of four nematode species. The vetch/corn cropping system increased the root-knot nematode population by 290% compared to the vetch/grain sorghum double cropping system. In contrast, the vetch/grain sorghum sequence increased the ring nematode population by 65% compared to the vetch/corn cropping system. Conventional and no-tillage treatments were equally infested by nematodes. In another oat/soybean double cropping study total soybean and oat root dry weight was equal for both conventional and no-tillage treatments aftter 10 years of tillage and cropping history. However, no-tillage had more root dry weight (79% of the total) in the upper 10 cm soil layer for soybean and in the upper 5 cm (85% of the total) for oat, as compared to the conventional treatment. This high concentration of roots near the soil surface in no-tillage has implications for management of fertilizer and water for no-tillage double cropping systems.

Publications: 88/01 to 88/09

GALLAHER, R.N., DICKSON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Effect of tillage and multicropping systems on the population dynamics of phytoparasitic nematodes. Anals of Applied Nematology. Accepted for publication.

ORTIZ, R.A. and GALLAHER, R.N. 1988. Evaluacion economica y respuesta del doble cultivo centeno soja a la aplicacion de nitrogeno y potasio en un sistems de labranza cero. Gaceta agronomica (Buenos Aires, Argentina). VIII (No. 43).

CORELLA, J., GALLAHER, R.N. and DICKSON, D.W. 1988. Effect of tillage and vetch-corn versus vetch-grain sorghum succession multicropping systems on population dynamics of phytoparasitic nematodes. Agronomy Dept., IFAS, Univ. of FL.

BUSTILLO, J. and GALLAHER, R. N. 1988. Partitioning of dry matter in fall-grown, no-tillage tropical corn in Florida. Agronomy Dept., IFAS, Univ. of FL, Agronomy Res. Rept. AY 88-04.

BRUNIARD, G.C. 1988. Double-cropped soybean/oat root growth and development affected by tillage. M.S. thesis, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.

ORTIZ, R.A. 1988. Nitrogen and potassium fertilization of a no-tillage rye-soybean double-cropping system. Ph.D. dissertation, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.

VAZQUEZ, L., MYHRE, D.L., GALLAHER, R.N., HANLON, E.A. and PORTIER, K.M. 1988.

17.002* CRIS0096488
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

KINLOCH R A; Agr Res Cntr; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 88/01 to 88/12. Winter planting of Cahaba White vetch, Vantage Purple vetch, ryegrass, and wheat were not significantly different from winter fallow in their effects on the soil infestation levels of the rootknot nematode Meloidogyne incognita and on subsequent galling and yields of rootknot susceptible (Hartz 7126) and resistant (Hartz 7110) soybean cultivars. Galling and yield of the susceptible cv over all winter treatments were 2.7 (on a scale of 0-4) and 1228 kg/ha; whereas those of the resistant cv weere 0.1 and 2269 kg/ha. Field studies were initiated to study the influence of summer planted crops (soybean, sorghum, maize, alyceclover, millet, sorghum X sundangrass, lespedeza, hairy indigo, peanut, aeschynomene, and cotton) on the abundance of Meloidogyne arenaria. In evaluations of 34 public and commercial cultivars and breeding lines at a site infested with M. arenaria, yields ranged from 111 kg/ha (DP 497, galling = 3.8 on a scale of 0-4) to 1591 kg/ha (Asgrow 6785, galling = 1.8). Yield of all cultivars (Y) was related to galling (X)

by Y = 2084-475X, r = -0.77 (P < 0.01). At a site infested with M. incognita yields ranged from 999 kg/ha (S69-96, galling = 2.6) to 2941 kg/ha (Coker 6847, galling = 0.3). Yield was related to galling as Y = 2691-430X, r = -0.65. At a site infested with the soybean cyst nematode Heterodera glycines (Race 3) yields ranged from 1221 kg/ha (Cobb) to 2793 kg/ha (Coker 6847).

Publications: 88/01 to 88/12

KINLOCH, R.A. 1988. Incidence of nematode trophic groups in a native woodland soil and in adjacent agricultural soil planted to various crops. Proc. Soil Crop Sci. Soc. Florida 47: 249-250.

KINLOCH, R.A. and RODRIQUEZ-KABANA, R. 1989. Rootknot nematode disease. In Compendium of soybean diseases. American Phytopathological Society. (In press).

17.003* CRIS0140217

NEMATODE PATHOLOGY AND MANAGEMENT IN AGRONOMIC CROPS OF THE SOUTHEASTERN COASTAL PLAIN

MINTON N A; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 6602-24000-006-00D Project Type: INHOUSE
Agency ID: ARS Period: 25 JUN 85 to 25 JUN 90

Objectives: To develop principles and practices of nematode control and management systems for agronomic crops that are economical, energy efficient, and environmentally safe and integrate them with other pest management practices for conventional and conservation tillage systems.

Approach: Maximize nematode control in agronomic crops using resistance rotations, multiple cropping, tillage and chemicals. Determine the interaction of nematodes with other pests in conservation tillage and multiple cropping and integrate with control of other pests to minimize use of chemicals and improve production. Assay soil at different levels in profile to determine rate of nematicide degredation and movement. Utilize laboratory,greenhouse, and field experiments. Obtain population densities of nematodes, fungi and insects, root damage indices, plant vigor ratings, stand counts, plant growth measurements, yield, and product quality. Collect data on peanut for developing peanut production models.

Progress: 87/01 to 87/12. In a double-crop minimum till (MT) experiment, peanut yields were the same following wheat and winter fallow. Moldboard plowed (MBP) plots produced 19% more and % sound mature kernels was greater than in plots planted by the subsoil-plant (SP) method. The nematode Meloidogyne arenaria and the fungus Sclerotium rolfsii were more severe in SP plots than in MBP plots. Also, Temik (3.4 kg ai/ha), the soil fungicide SN84364 (2.2 kg ai/ha), and the combination increased yields 14%, 52% and 81%, respectively. Two formulations of methyl bromide applied without tarp reduced M. arenaria damage and increased peanut yields. The greatest increase of 823 kg/ha occurred for Terr-O-Cide (67 kg ai/ha). Temik (1.7 kg ai/ha) applied postplant to the methyl bromide treated plots increased yields an average of 672 kg/ha. A proprietary nematicide, F5145, reduced M. arenaria damage and increased peanut yields at two rates: 4.9 kg ai/ha, 738 kg/ha and 7.4 kg/ha, 659 kg/ha. Yield differences were not significant when soybean was planted by the SP method in rye stubble and in fallow soil infested with M. incognita. However, cultivar yields were different and Temik (3.4 kg ai/ha) increased yields 61.5%. Host tests and morphological features of a Meloidogyne incognita isolate were not typical for any previously described M. incognita race. Improved nematode, disease and insect control in MT and conventional tillage will increase profits and/or reduce soil erosion which will benefit the producer and consumer.

Publications: 87/01 to 87/12

MINTON, N.A., GOLDEN, A.M., and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.

MINTON, N.A., LEONARD, R.A., and PARKER, M.B. 1987. Concentration of phenamiphos in the profile of a sandy loam soil as affected by tillage and time. J. Nematol. 19:544. (Abstract).

MINTON, N.A., and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. J. Nematol. 19:38-43.

SUMNER, D.R., and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

17.004* CRIS0074740

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

MALEK R B; Plant Pathology; 1301 West Gregory Drive, Urbana, **ILLINOIS** 61801.
Proj. No.: ILLU-68-0381 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the variability in nematode-host interactions and determine the relationships among host, abiotic factors, and crop losses caused by plant parasitic nematodes.

Approach: The impact of primary crop species and cultivars on populations of principal nematode parasites under greenhouse and field conditions will be analyzed using mono- and polyspecific nematode communities. Temperature and moisture effects on nematode developmental biology, population development and pathogenicity will be clarified under controlled conditions. Growth and yield responses of primary crops to parasitism by nematodes under field conditions will be correlated with annual growing season weather, soil type, tillage practice and fertility regime.

Progress: 86/10 to 87/09. Post-emergence application of liquid nitrogen to dent corn via simulated fertigation in mid and late June to mitigate early-season damage to plants by the needle nematode Longidorus breviannulatus on sandy soil not treated with a nematicide increased yield 48% over that of corn fertigated once at double-rate in late June in 1986 (data not available at reporting time). Yield of the twice-fertigated, untreated corn was 30% less than that of similarly fertigated corn treated at planting with aldicarb and was equivalent to yield of untreated corn sidedressed with dry nitrogen between rows twice in June. Nitrogen fertigation in early in fertigation in early, mid and late June in 1987 improved stand appearance of nematode-damaged seedlings on untreated soil, but plant response was less than in 1986 beacuse of unusually rapid crop development. Under abnormally high early-season temperature conditions and in contrast to results in the prior year, at-planting treatment with aldicarb provided much abbreviated protection of roots from parasitism by L. breviannulatus and did not effectively suppress nematode population development. Yield comparison data are not yet available.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

17.005* CRIS0092702
ECOLOGY, PATHOLOGY, AND CONTROL OF NEMATODES ON CULTIVATED AND NATIVE GRASSES

TODD T C; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00508 Project Type: STATE
Agency ID: SAES Period: 01 JUL 84 to 30 JUN 87

Objectives: To identify phytophagous nematodes associated with cultivated and native grasses. To study pathogenic potential and yield losses due to nematodes. To evaluate control procedures. To investigate nematode interactions with other factors. To determine the importance of nematodes in native prairie grass ecosystems.

Approach: Soil samples will be collected and the nematodes extracted, identified, and counted. Pathogenicity studies will be conducted in the greenhouse and nematicide plots will be established in the field. In vitro interaction studies will be initiated. Nematode trophic levels will be monitored on selected sites of native tall-grass prairie.

Progress: 83/07 to 87/06. Nematodes identified as having an economic impact on grasses in Kansas include an undescribed species of Belonolaimus (close to B. nortoni) and Pratylenchus scribneri on corn, Tylenchorhynchus martini on sorghum, and Hoplolaimus galeatus galeatus on bentgrass. The estimated damage potential of Belonolaimus sp. was 1-3% of seed-corn weight/nematode. A midsummer soil density of approximately 300 H. galeatus/100 cm was determined to approach the threshold level for visual turf damage. Nematicide efficacy was evaluated in multi-year field tests for selected nematode-host systems. Consistent control of corn nematodes was achieved with at-planting applications of carbofuran and Terbufos at 1.1-2.2 kg/ha. Broadcast application of fenamiphos at 4.6 lb/1000 sq ft reduced populations of turf nematodes and improved turf quality. Observations on the interaction of nematodes and other soil fauna in below ground processes were collected from several tallgrass prairie sites. Nematicide-induced reductions in soil populations of free-living nematodes resulted in a 15% increase in dead roots, presumably due to disturbance of decomposition processes. Primary production of the tallgrass prairie was not affected by changes in nematode densities. In a study using mowing regimes to simulate grazing intensities, a decrease in the percentage of live roots due to mowing was correlated with a decrease in numbers of obligate plant-feeding nematodes and an increase in numbers of bacteria-feeding nematodes.

Publications: 83/07 to 87/06
SEASTEDT, T.R., TODD, T.C., and JAMES, S.W. 1987. Experimental manipulations of arthropod, nematode, and earthworm communities in a North American tallgrass prairie. Pedobiologia 30:9-17.

17.006* CRIS0131303
IDENTIFICATION, BIOLOGY, AND MANAGEMENT OF AGRICULTURALLY IMPORTANT PLANT PARASITIC NEMATODES

MCGAWLEY E C; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02587 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 SEP 91

Objectives: To identify nematode genera, species, and races parasitic on major Louisiana crop plants. To evaluate the influence of other major plant pest groups on nematode population ecology and pathogenicity. To investigate methods useful in reducing nematode-related plant injury.

Approach: Nematode survey, greenhouse host differential testing for nematode race identification, light microscopy of nematode and plant characteristics. Field plot experiments, microplot research. Laboratory, greenhouse, and field experimentation with natural and synthetic nematicides.

Progress: 87/01 to 87/12. In numerical order, with the frequency of detection indicated in parentheses immediately after, the distribution of the five known races of the Soybean Cyst Nematode (as represented by 162 soil samples collected from the 13 major soybean producing parishes) in Louisiana is as follows: race 1 (7); race 2 (24); race 3 (68); race 4 (30); race 5 (15) and, questionable race (18). Results of greenhouse studies conducted to assess the interaction or lack thereof between the Soybean Cyst Nematode and the Red Crown Rot disease pathogen, Calonectria crotalariae, indicates that the reproduction f

each organism is augmented in the presence of the other. Disease effects are additive. Penetrsation of root tissues of cyst nematode resistant plants is significantly increased when it is infected with the fungus. Race 2 of Meloidogyne incognita (Mi-2) is the most common one associated with soybeans in Louisiana. Cultivars which contain resistance to this nematode are available. Cultivars with resistance to Mi-2, but which are severely galled have been observed under field conditions with increasing frequency during the last two years. These cultivars contain both Mi-2 and M. iavanica.

Publications: 87/01 to 87/12

OVERSTREET, C. and MCGAWLEY, E.C. 1987. Influence of Calonectria crotalariae on reproduction of Heterodera glycines on resistant and susceptible soybeans. Journal of Nematology. (In press).

RUSSIN, J.S., LAYTON, M.B., BOETHEL, D.J., MCGAWLEY, E.C. SNOW, J.P. and BERGGREN, G.T. 1987. Interactions of Heterodera glycines with Diaporthe phaseolorum var. caulivora and insect-induced defoliation on soybean.

RUSSIN, J.S., LAYTON, M.B., MCGAWLEY, E.C. BOETHEL, D.J. and SNOW, J.P. 1987. Interactions between soybean looper, stem canker fungus, and soybean cust nematode on soybean. Phytopathology 77: (In Press).

LAYTON, M.B., RUSSIN, J.S., MCGAWLEY, BOETHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Effects of insect-induced defoliation, stem canker disease, and soybean cyst nematode on soybean growth and N(2) fixation.

MCGAWLEY, E.C. and WINCHELL, K.L. 1987. Greenhouse reproduction of single and combined Meloidogyne incognita and M. javanica on soybean. Journal of Nematology 19: (In Press).

17.007* CRIS0027934

PLANT DISEASE SURVEY AND SPECIAL INVESTIGATIONS

WYSONG D S; WATKINS J E; BOOSALIS M G; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.

Proj. No.: NEB-21-001 Project Type: STATE
Agency ID: SAES Period: 01 JUL 66 to 13 MAR 89

Objectives: Monitor plant disease occurrence; determine casal agents of new diseases; deliniate geographic distribution of new and recurring diseases on a periodic basis; make preliminary studies on severity of new or certain recurring diseases; develop judments on feasibility of short-term versus long-term investigations on certain diseases.

Approach: Conduct periodic field examinations for diseases on field crops with particular attention to alfalfa, corn, sorghum, soybeans and wheat; record and maintain records of pathogen identification, disease severity and location, host, and other pertinent data; conduct further study of specific plant diseases collected on survey; study applicability of practical control measure for economically important diseases.

Progress: 87/01 to 87/12. SOYBEANS: A soybean cyst nematode (SCN) survey was conducted in an 8-county area bordering the Missouri River between Richardson County on the south and Burt County on the north. A total of 130 soybean fields were included in the survey, which was initiated in late July and completed in mid-August, 1987. Assays of soil and plant roots collected on survey resulted in the identification of 13 "new" infested fields. The number of fields surveyed by county and the number of confirmed SCN fields (in parentheses) is as follows: Richardson - 20 (4), Nemaha - 20 (2), Otoe - 20 (1), Cass 10 (1), Sarpy - 13 (2), Douglas - 7 (1), Washington - 20 (0), and Burt - 20 (2). While all of the infested fields are associated with low-lying, river bottomland soils, four of the fields were located in the central or western sections out of the Missouri floodplain region. Three of these fields were in Richardson and one was in Douglas counties. SORGHUM: A sorghum downy mildew survey was conducted in a 35-county area in south central, east central and southeastern Nebraska in order to determine the incidence and severity of the disease in commercial fields. A minimum of four fields were selected at random in each county. The disease was found to occur in 17 of the 35 counties; it was considered severe and, in a few fields, was felt to be yield-limiting in a four-county area including Nuckolls, Thayer, Fillmore and Clay counties.

Publications: 87/01 to 87/12

POWERS, T. and WYSONG, D.S. 1988. Soybean Cyst Nematode in Nebraska. Crop Prot. Clinic Proc., pgs. 146-148.

JENSEN, S.G., WYSONG, D.S. and DOUPNIK, B., JR. 1988. Sorghum Downy Mildew, The Disease and its Control. Crop Prot. Clinic Proc., pgs. 123-127.

17.008 CRIS0066983

CONTROL OF THE EFFECTS OF PLANT PARASITIC NEMATODES ON WHEAT AND FORAGE CROPS

RUSSELL C C; SINGLETON L L; BURTON R L; Plant Pathology; Oklahoma State University, Stillwater, **OKLAHOMA** 74078.

Proj. No.: OKL01585 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 85 to 30 SEP 90

Objectives: Determine: modes of action, particularly non-nematicidal modes, of commercial nematicides; effects of root diffusates on resuscitation of anhydrobiotic nematodes; influence of nematicide application methods on nontarget pathogen population. Develop nematicide application techniques to the level of economical utilization.

Approach: Above studies will utilize a soil diffusion gradient system that will allow assessment of results over a continum of nematicide concentration in the soil.

Progress: 87/10 to 88/09. The mode of action of the nematicide carbofuran is based on disruption of nematode orientation responses in addition to direct nematicidal activity. Application of this nematicide at the reportedly subnemticidal dosages of .28, .56,

and 1.12 kg/ha (rate per 15932.5m of treated row applied infurrow on 25.4 cm centers) was made to all rows (=BRD) or to alternate rows, only (=ALT, which halves the rate of both chemical and carrier compared to BRD). These treatments were compared to the control (water only, 46.81/ha BRD) on the basis of nematode populations and wheat yield. Although yield differences appeared reduced by abundant soil moisture and late planting, increased yields, averaged across 3 locations, were obtained for all nematicide treatments (forage 112 to 126, and grain 103 to 109% of control). ALT treatments accounted for the majority of the significant (P=less than or equal to .10) yield increases (forage 71%, grain 66%). The beneifit ratio for grain yield (kg yield increse over control/kg chemical applied per ha) of the treatments was: .28kg/haALT=634, .28kg/haBRD=271, .56kg/haALT=228, .56kg/haBRD=206, 1.12kg/haALT=156 and 1.12 kg/haBRD=38. Paratylenchus, Merlinius and Pratylenchus spp. population reductions were obtained with the greatest number of significant (P=less than or equal to .10) reductions occurring in the ALT treated rows.

Publications: 87/10 to 88/09

RUSSELL, C.C. 1987. A simple, Inexpensive, High Resolution, In vitro Root Dbservation Technique. Nematologica 33:(1):119-122.

RUSSELL, C.C. and SINGLETON, L.L. 1988. Nematicide Applications on Winter Wheat, Strategic and Economic Considerations. Proc. Okla. Agric. Chem. Conf. 13:60-63.

SINGLETON, L.L., RUSSELL, C.C. and MERRILL, W.H. 1988. Wheat Root Rot and Nematode Research. Ann. Wheat Newsletter 34:155-156.

WILLIAMS, E., RUSSELL, C.C., STURGEON, R.V. and BARNES, G.L. 1988. Soil and Plant Sampling for Analysis of Nematode Populations. OSU Extension Facts No. 7610, 2 p.

17.009 CRIS0135369

WHEAT ROOT ROT DISEASE CONTROL

SINGLETDN L L; RUSSELL C C; Plant Pathology; Oklahoma State University, Stillwater, **OKLAHOMA** 74078.

Proj. No.: DKL01574 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: To identify important soilborne pathogens, and study their epidemiology. To develop biological and/or other methods for controlling Pythium spp. infection in field soils. Continuation of research to characterize toxic metabolite production by Pythium arrhenomanes. Evaluate host germplasm for resistance to Pythium spp. found in wheat soils.

Approach: Monitor Pythium populations. Develop method for quantifying Pythium spp. infection/g of roots, identify spp., determine pathogenic ratios, and root and soil populations. Root isolates of actinomycetes and bacteria evaluated for in vitro antagonism against Pythium arrhenomanes, Bipolaris sorokiniana, and Fusarium graminearum. Isolate testing will be under controlled conditions in field soils. Field testing of fungicides and biocontrol organisms using ultra low volume (ULV) application methods will be done. Characterize Pythium arrhenomanes metabolites: production, purification, bioassay, identification, structure, and host responses. Wheat genotypes with suspected resistance to several Pythium spp. will be evaluated in infested soils for percent infection, emergence and growth differences.

Progress: 87/10 to 88/09. Wheat Root Rot--In growth chamber studies, the effects of Fusarium avenaceum and Drechslera sorokiniana (each alone and in combination) on yield, evapotranspiration and stomatal resistance of six hard red winter wheat cultivars (Payne, Triumph 64, Danne, Vona, TAM 101, and Newton) were evaluated under soil moisture stress conditions. The pathogens reduced the forage and root yields of all cultivars. Evapotranspiration rates of the diseased plants were not significanly affected by either pathogens alone or in combinations as compared to healthy controls. The pathogens did not significantly affect the stomatal resistance, but F. avenaceum alone tended to increase stomatal resistance while D. sorokiniana alone and both pathogens caused a decrease in stomatal resistance. Root and forage yield results suggest that Payne was the most tolerant cultivar and Newton was the most susceptible to effects of these pathogens under the moisture stress conditions.

Publications: 87/10 to 88/09

UMECHURUBA, C.I., SINGLETDN, L.L. and KIRKHAM, M.B. 1986. Effect of Drechslera sorokiniana and Fusarium avenaceum on root and shoot yield.

UMECHURUBA, C.I. and SINGLETDN, L.L. 1988. Effects of Cochliobolus sativus and Gibberella avenacea on transplanted and non-transplanted wheat seedlings grown under soil-moisture stress conditions. Fitopatol. bra. (13):05-07.

UMECHURUBA, C.I., SINGLETDN, L.L. and KIRKHAM, M.B. 1986. Effect of Drechslera sorokiniana and Fusarium avenaceum on root and shoot yield.

UMECHURUBA, C.I. and SINGLETON, L.L. 1988. Effects of Cochliobolus sativus and Gibberella avenacea on transplanted and non-transplanted wheat seedlings grown under soil-moisture stress conditions. Fitopatol. bra. (13):05-07.

RUSSELL, C.C. and SINGLETON, L.L. 1988. Nematicide Applications on Winter Wheat, Strategic and Economic Considerations. Proc. Okla. Agric. Chem. Conf. 13:60-66.

SINGLETDN, L.L., RUSSELL, C.C. and MERRILL, W.H. 1988. Wheat root rot nematode research. Ann. Wheat Newsletter 34:155-156.

17.010* CRIS0131089

DISTRIBUTION, ECDLOGY AND PATHDGENICITY OF RDOT-KNDT NEMATODE (MELOIDDGYNE SPP.)

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SDUTH CAROLINA** 29634.

Proj. No.: SC01225 Project Type: HATCH

Agency ID: CSRS Period: 01 APR 87 to 30 MAR 92

Objectives: Determine the subspecific identity of geographical isolates of Meloidogyne spp. in soybean, cotton, and tobacco; determine environmental and edaphic conditions under which physiologic development is favored; and evaluate various host and nonhost plants for nematode management in potential cropping systems.

Approach: Geographical isolates of Meloidogyne incognita and M. arenaria will be identified using host differential plants, perineal patterns of females, male lip shape, cytology, and esterase enzyme profiles. Soil structure, moisture, and temperature relationships will be assessed for their importance in reproduction and aggressiveness of several M. incognita isolates. Life tables will be constructed after determining activity and developmental thresholds of the isolates. Physical and moisture characteristics of two soils will be studied for their influence on egg hatch, movement, invasion, and reproduction. The host suitability of different cultivars of corn, wheat, and sorghum will be assessed against selected isolates of M. incognita. Mass screening of nematode isolates and plant cultivars will be done in the greenhouse and field. This information will be used to develop an economic model of root-knot nematode management.

Progress: 87/04 to 87/12. Greenhouse and laboratory experiments were performed to determine if an interaction exists between Meloidogyne incognita and Hoplolaimus columbus on Davis soybean. Greenhouse tests were performed with three population levels of M. incognita and H. columbus (0, 15,00, 6,000/1.5-liter pot) separately and in all combinations. Dry root weight (DRT) declined nonlinearly and dry shoot weight (DST) declined linearly with respect to increasing initial populations of M. incognita and H. columbus. When the two nematode species were added to the soil together, the amount of DRT and DST suppression by one species was dependent on the initial level of the concomitant species. The final root population of M. incognita or H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus suppressed M. incognita populations in the soil nonlinearly, but M. incognita had no effect on H. columbus. In other tests, using root explants of M. incognita-susceptible Davis and M. incognita-resistant Centennial, roots parasitized by M. incognita are more attractive to H. columbus than roots of susceptible, and especially M. incognita-resistant soybean ccultivars infected by H. columbus. In susceptible Davis, H. columbus is not only attracted to M. incognita-infected roots but also penetrates these roots more readily than noninfected roots.

Publications: 87/04 to 87/12

GUY, D.W., JR. and LEWIS, S.A. 1987. Selective migration and root penetration by Meloidogyne incognita and Hopololaimus columbus on soybean roots in vitro. J. Nematol. 19:390-392.

GUY, D.W., JR. and LEWIS, S.A. 1987. Interaction between Meloidogyne incognita and Hopolaimus columbus on Davis soybean. J. Nematol. 19:346-351.

17.011 CRIS0093907

BIOLOGY AND MANAGEMENT OF SELECTED SOYBEAN DISEASES

MUELLER J D; Plant Pathology & Physiology; Edisto Res & Educ Center, Blackville, **SOUTH CAROLINA** 29817.

Proj. No.: SC01098 Project Type: STATE

Agency ID: SAES Period: 01 SEP 84 to 31 AUG 87

Objectives: Determine the races of soybean cyst nematode (Heterodera glycines) present in South Carolina and typify any populations which do not fit one of the five described races. Determine the incidence and severity of stem canker on soybeans in South Carolina and evaluate date of planting, varietal resistance, and fungicides as control measures. Determine the effect of a wheat-soybean double cropping system on the management of lance nematode and fungal diseases of soybeans. Establish rates of nematicides on soybeans.

Approach: Cyst populations will be collected from commercial fields and typified using a set of differential soybean cultivars. Visual ratings will be made on the incidence and severity of ten cultivars planted at two dates. Efficacy of fungicides on a stem canker susceptible cultivar will be visually rated. Reproduction of lance nematode and severity of fungal diseases will be determined on wheat and soybean cultivars grown in a three year double-crop system.

Progress: 84/09 to 87/08. Six soybean cultivars which varied in susceptibility to Diaporthe phaseolorum var caulivora were planted on two planting dates at a total of 5 locations over 2 years. The incidence of naturally occurring stem canker was too low each year to allow comparisons. Thirty-nine soybean cultivars were field screened at a total of 5 locations over 3 years in North Carolina and South Carolina for tolerance to Hoplolaimus columbus (HC). Cultivars exhibiting the greatest tolerance to HC were 'Asgrow 6785', 'Coker 368', 'Coker 488', 'Kirby', 'RA 680', and 'Young'; the least tolerant were 'Asgrow 6381', 'Braxton', 'Coker 596', 'Hartz 5171', 'McNair 770', and 'Perrin'. Sixteen soybean cultivars were evaluated for performance in a field infested with Heterodera glycines race 3 and Meloidogyne incognita. Yield (kg/ha) was highest for Centennial (1519 kg/ha, 5 new cysts/100 cm soil, galling index of 0.4), Coker 485 (1202, 6, 0.6), Kirby (1519, 0, 0.6), and Gordon (1276, 1, 1). Efficacy of 1.7 and 0.7 kg ai/ha rates of aldicarb 15G, carbofuran 15G, and Fenamiphos 15G was measured on three cultivars varying in susceptibility to (HC) ('Braxton' - susceptible, 'Centennial-tolerant', 'Foster'-tolerant). Mean yield of the 3 cultivars for three years were 1291, 1581, 1668 kg/ha respectively. Mean yield

for 2 years over the treatments for the cultivars were 1601, 1628, and 1722 kg/ha respectively. The two aldicarb rates provided equivalent yield increases.

Publications: 84/09 to 87/08

MUELLER, J., SULLIVAN, M. and TURNIPSEED, S. 1986. Control of Hoplolaimus columbus using granular nematicides and tolerant cultivars. J. Nematol. 18:622 (abstr.).

MUELLER, J.D., SHIPE, E.R. and MUSEN, H.R. 1986. Evaluation of soybean cultivars for tolerance to Hoploilaimus columbus. J. Nematol. 18:639 (abstr.).

MUELLER, J.D., MUSEN, H.L. and SHIPE, E.R. 1986. Evalation of resistance in soybean to a combination of root-knot and cyst nematodes. Biological and Cultural Tests for Plant Disease Control 1:35.

MUELLER, J.D. 1986. Evaluation of Telone II for Columbia lance nematode control, 1985. Fungicide and Nematicide Tests 41:79.

MUELLER, J.D. 1986. Evaluation of Telone II for soybean cyst nematode control, 1985. Fungicide and Nematicide Tests 41:80.

MUELLER, J.D. and SANDERS, G.B. 1987. Control of Hoplolaimus colubus on late planted soybean with aldicarb. Annals of Applied Nematology 1:123-126.

MUELLER, J.D. 1988. Efficacy of aldicarb in-furrow and banded on soybean cyst nematode, 1985. Fungicide and Nematicide Tests Volume 43: (in press).

17.012* CRIS0141411

DEVELOP NEW CONTROL STRATEGIES FOR DIABROTICA SPP. AND CEREAL APHIDS

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Agricultural Research Service, Brookings, **SOUTH DAKOTA** 57006.

Proj. No.: 5447-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 01 APR 91

Objectives: 1) Develop mathematical models of population dynamics; 2) identify patho- gens, parasites, and predators of Diabrotica spp. and cereal aphids; 3) develop semiochemical based technology; 4) role of insecticides for management; and 5) model systems for rearing of Diabrotica spp.

Approach: 1. Using system science methodology, construct models of population pro- cesses of Diabrotica spp. and cereal aphids to improve monitoring and pre- diction capabilities for IPM. 2. Evaluate biological control agents of Diabrotica spp. and cereal aphids and host/parasite/environment inter- actions. 3. Semiochemical mixtures will be evaluated in the field for suppression of adult Diabrotica, establishing environmental parameters, application strategies, and efficacy of formulations. 4. Study fate and efficacy of soil insecticides for management of Diabrotica in new crop production systems emphasizing reduced tillage. 5. Methodology and models will be developed to reduce production costs and improve rearing efficacy.

Progress: 87/01 to 87/12. Models describing the population dynamics of the western corn rootworm (WCR) and 5 species of cereal aphids were developed and partially validated in the laboratory and field. These models will be useful in predicting and sampling of pests' stages, determining rates of reproductive development, oviposition, and survival and how host phenology affects pest biology. High densities of immature WCR populations increased pest development time and decreased survival rate. Behavioral responses of semiochemicals were evaluated in mixed populations of WCR and northern corn rootworms (NCR). Responses to pheromone isomers differed by species and they may be of limited value in semiochemical-toxicant baits. A new diet was developed for adult WCR that is equal nutritionally to previous diets but improves rearing effficiency. Virus-like particles were found in testes of WCR colonies that are believed to cause deformed sperm and significantly reduce egg viability. A cultivation-time application of the entomogenous nematode, Steinernema feltiae, reduced feeding by WCR larvae but less than an insecticide treatment. Poor control was due to lack of persistence of nematodes in the root zone and poor vigor. Eggs were obtained from field-collected Mexican corn rootworms that will be used to determine larval insecticidal responses. Persistence of granular insecticides in alkaline soils in Texas (pH 7.5-8.0) was approximately 1/3 that in mid-western soils.

Publications: 87/01 to 87/12

BRANSON, T.F. 1987. The contribution of prehatch and posthatch development to protandry in the chrysomelid, Diabrotica virgifera virgifera. Entomol. exp. appl. 43:205-208.

BRANSON, T.F. and KRYSAN, J.L. 1987. Laboratory biology of Diabrotica tibialis and a closely related Diabrotica species (Coleoptera: Chrysomelidae). J. Kansas Entomol. Soc. 60:446-450.

BRANSDN, T.F., JACKSDN, J.J., and SUTTER, G.R. In press. Improved method for rearing Diabrotica virgifera virgifera (Coleoptera: Chrysomelidae) J. Econ. Entomol. Accepted 29 June 1987.

JACKSDN, J.J. and ELLIDTT, N.C. In press. Temperature-dependent development of immature stages of the western corn rootworm, Diabrotica virgifera virgifera. Environ. Entomol. Accepted 22 September 1987.

LANCE, D.R. In press. Responses of northern and western corn rootworms to semiochemical attractants in corn fields. J. Chem. Ecol. Accepted 23 June 1987.

ELLIDTT, N.C. and KIECKHEFER, R.W. 1987. Spatial distributions of cereal aphids in winter wheat and spring oats in South Dakota. Environ. Entomol. 16:896-901.

WALGENBACH, D.D., ELLIDTT, N.C. and KIECKHEFER, R.W. In press. Constant and fluctuating temperature effects on developmental rates and life table statistics of the greenbug (Homoptera: Aphididae). J. Econ. Entomol. Accepted 14 Sept 1987.

17.013 CRIS0094346
BIOLOGICAL CONTROL OF SOIL-BORNE PLANT PATHOGENS IN INTEGRATED CROP MANAGEMENT SYSTEMS

BUCHENAU G W; SMOLIK J D; RIZVI S A; Plant Science; S Dakota State University, Brookings, **SOUTH DAKOTA** 57007.
Proj. No.: SD00234 Project Type: HATCH
Agency ID: CSRS Period: 09 OCT 84 to 30 SEP 89

Objectives: To develop biotic agents for plant disease control. To assess the effect of tillage and crop residue management practices on soil micro-organisms and plant health. To integrate biological control into crop disease management systems.

Approach: We will attempt to develop biocontrol agents effective against certain soil-borne pathogens of wheat and alfalfa including Cochliobolus sativus, Fusarium graminearum, Pythium ultimum, Pyrenophora tritici-repentis and selected nematode species by searching for soils suppressive to these pathogens and isolating biocontrol agents from such soils, or by stimulating populations of biocontrol agents by periodic reinfestation of soil with the target organisms. Mutants of antagonistic Gliocladium and Trichoderma spp that are more effective at low temperature and high pH, and which have tolerance to appropriate fungicides will be developed for use in integrated disease control systems. Effect of minimum tillage and organic farming systems on Fusarium, Pythium and nematode populations will be studied at selected sites, and the fate of C. sativus spores will be studied under various tillage systems at Doland.

Progress: 87/01 to 87/12. In a field experiment, seed treatment of wheat with Gliocladium virens reduced the number of heads per row in natural soil, but increased the number of heads per row in soil artificially infested with Pythium ultimum (PU) or Cochliobolus sativus (CS). Both pathogens reduced the number of heads of untreated wheat. Pythium oligandrum seed treatment increased head numbers in CS infested soil, but a similar increase in PU soil was not significant at the 5% level. G. virens was not as good as Vitavax 200 in natural soil, and P. oligandrum was not as good as Vitavax 200 in PU soil, otherwise, the biocontrols did not differ statistically from the standard. None of the treatments affected weight per kernel. Soils suppressive to Pythium and to CS have been detected in certain soils from a series of rotation-tillage studies, but suppressiveness has not been consistently associated with treatment nor with measured microbial variables. Chloride fertilization of wheat resulted in significant yield increases at one location but not at a second location in 1987. There was not a significant effect of chloride on common root rot as indicated by subcrown internode necrosis, but leaf disease was reduced by chloride at the responsive site. Leaf rust, Septoria blotch and tan spot all were reduced to some degree. Yield response of cultivars to chloride was not always explained by foliage disease reduction. However, there was virtually no leaf disease present at the site with no yield response to chloride.

Publications: 87/01 to 87/12
BUCHENAU, G., RIZVI, S. and AHMED, I. 1987. Effect of foliage fungicides on diseases of spring wheat in South Dakota. APS Fungicide-Nematicide Tests 42:114-115.
CHOLICK, F.A., GELLNER, J.L., BUCHENAU, G.W., SCHUT, R. and RIZVI, S. 1987. South Dakota Wheat. Ann. Wheat News. 33:162.
SMOLIK, J.E., ET AL. 1986. Farming Systems Studies. Northeast Exp. Sta. Ann. Prog. Rep. Plant Sci. Pamph. 100:25-42.

17.014 CRIS0081178
INTEGRATED APPROACHES TO MANAGEMENT OF DISEASE CAUSED BY SOIL-BORNE PLANT PATHOGENS ON FIELD CROPS

BUCHENAU G W; SMOLIK J D; YAHNKE M D; Plant Science; S Dakota State University, Brookings, **SOUTH DAKOTA** 57007.
Proj. No.: SD00309 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 79 to 30 SEP 84

Objectives: Monitor the effects of specific cultural practices on pathogen populations and subsequent disease development. Determine the effects of soil and rhizosphere environment on pathogen populations their activity and survival. Determine the resultant effect of single and combined pest management practices on soil pathogen populations and subsequent disease development over a normal range of seasonal weather conditions.

Approach: Populations of Cochliobolus sativus and Gibberella zeae will be monitored in various cultural practices at Redfield and Highmore on spring wheat and the effect of organic amendments on spore viability and crown rot will be evaluated. Effect fungicides on crown rot and winter survival will be studied at Doland and Highmore under natural conditions and at Brookings under both natural and artificially inoculated conditions. Isolates of several fungi will be evaluated as components of the winter kill complex in field and greenhouse experiments at Brookings. Ultimately integrated controls for crown rot, nematodes and hessian fly will be formulated and tested.

Progress: 79/10 to 84/09. Cochliobolus sativus crown rot of spring wheat was less severe under Noble-blade tillage than under no-till or conventional till systems. The data also suggest that there is a fundamental difference between Noble blade and no-till, the former usually had less crown rot. Plant parasitic nematodes increased most rapidly under no-till, whereas rates of increase were about equal in conventional and Noble blade tillage. At planting, there were about half as many nematodes in Noble blade plots, and final populations were 250, 430 and 800 nemas/100 cc in Noble, conventional and no-till, respectively. Pythium populations were not affected by tillage in 1984, unlike previous years. Populations of fluorescent pseudomonads were substantially lower in conventional tillage than under residue. Biological control of alfalfa seedling blight using seed treatment with Gliocladium virens was nearly as effective as metalaxyl over a wide range of temperature,

moisture, pH and inoculum environments in the green house, and in field experiments. The hypothesis that seed treatment of scabby wheat is most beneficial at warm soil temperatures was verified under greenhouse conditions but was not adequately tested in field environments. At one location, wheat yield increases from chloride fertilizer could be explained by reduction in tan spot and leaf rust; no effect on crown rot was detected.

Publications: 79/10 to 84/09
ND PUBLICATIONS REPDRTED THIS PERIOD.

17.015* CRIS0143120
BIOLOGY AND CONTROL OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH FIELD, FORAGE, AND RANGELAND PLANTS

GRIFFIN G D; Agricultural Research Service, Logan, **UTAH** 84322.
Proj. No.: 5428-24000-002-00D
Project Type: INHDUSE
Agency ID: ARS Period: 04 AUG 88 to 03 AUG 93

Objectives: Determine the biological relationship between plant parasitic nematodes andfield, forage, and rangeland vegetation. Determine the ecological and environmental impact of soil-borne organisms on the host-parasite relation-ship between nematodes and plants. Determine the importance of cultural practices, soil types, and control methodologies on nematode population dynamics and host-parasite associations. Develop pest management procedures that will reduce crop/environmental losses caused by nematodes.

Approach: Determine species and population dynamics of plant parasitic nematodes associated with the growth and development of forage, rangeland vegetation,grains, and other field crops under natural and artificial conditions with macro and microstudies. Measure crop losses in relation to nematode-environmental relationships and qualitative-quantitative analyses. Evaluatenematode control methodologies to determine most efficaciouss method(s) with minimal effect on envionmental impact and ecosystem balance. Measure importance of interactions between nematode and pathogenic and beneficial microbes on the growth of plant cultivars using proven and newly developed techniques and methodologies.

17.016* CRIS0049759
BIOLOGY AND CONTROL OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH FIELD, FORAGE AND RANGELAND PLANTS

GRIFFIN G D; Agricultural Research Service; Agricultural Research Service, Logan, **UTAH** 84322.
Proj. No.: 5428-24000-001-00D
Project Type: INHDUSE
Agency ID: ARS Period: 01 DCT 84 to 30 SEP 88

Objectives: Determine namatode species associated with field, forage & rangeland vegetation. Determine host-nematode relationship on field, forage & rangeland plants. Determine importance of environment, associated soil borne organisms, soil types, cultural practices, & control of methodologies (resistance, tolerance, biological, physical & chemical) on nematode population dynamics & host/parasite relationships. Develop IPM technologiesthat will reduce and control nematode numbers & nematode related diseases.

Approach: Measure crop losses in relation to namatode population thresholds, nematode-environmental relationships, and qualitative-quantitative analyses. Evaluate nematode control methodologies to determine most efficacious method(s) with minimal effect on environmental impact and ecosystem balance; study nematode biology and host/parasite relationships with macro and microstudies involving manipulation of nematode populations,intrinsic and extrinsic factors, and varying cultural practices. Measure importance of interactions between nematode, and pathogenic and beneficial microbes on forage, field, and range plants under different environmental conditions.

Progress: 87/01 to 87/12. Nematode resistant alfalfa, Nevada Synthetic XX, differed in its response and degree of resistance to Meloidogyne hapla populations from California, Utah, Washington, and Wyoming, and was 100% susceptible to one California population; Ranger alfalfa was 100% susceptible to all populations. Species of Astragalus, Coronilla, Hedysarum, Lathyrus, Lotus, Medicago, Melilotus, Dnobrychis, Trifolium, and Vicia differed in susceptibility and nitrogen fixation to Meloidogyne hapla and M. chitwoodi populations. Population densities of Merlinius brevidens, Quinisulcius acutoides, and Pratylenchus neglectus are greater under continuous no-till and chemical fallow no-till regimentations than other conventional fallow cultivation of wheat. The susceptibility of resistant Apollo II and Nevada Synthetic XX, and susceptible Ranger alfalfas to combined inoculations of M. hapla and Phytophthora megasperma f. sp. medicaginis was greatest at 28 C. There was a direct relationship between M. hapla and M. chitwoodi population densities and the growth of Lahontan alfalfa, Hycrest wheatgrass, and Russian wildrye in a competitive plant study; increased nematode population densities reduced plant growth of both resistant and susceptible plants.

Publications: 87/01 to 87/12
GRIFFIN, G.D. 1987. The importance of environmental factors and cultural practices on parasitism of alfalfa by Ditylenchus dipsaci. J. Nematol. 19: 267-276.
GRIFFIN, G.D. 1987. The interaction of Ditylenchus dipsaci and Meloidogyne hapla on susceptible and resistant plants. J. Nematol. 19:441-446.
GRIFFIN, G.D. 1987. Efficacy of using split and post-plant applications of aldicarb to control Heterodera schachtii on sugarbeet. Ann. Applied Nematol. 1:119-122.

GRIFFIN, G.D. 1987. Nonvolatile nematicide control of Heterodera schachtii on sugarbeet. J. Am. Soc. Sugarbeet Tech. Accepted July 20, 1987.
EISENBACK, J.D., and GRIFFIN, G.D. 1987. Interactions with other nematodes. pp. 313-320. In: VEECH, J.A. and DICKSON, D.W. (eds.) Vistas on Nematology. Hyattsville, MD, Society of Nematologists, Inc.
GRIFFIN, G.D., and THYR, B.C. Interaction of Meloidogyne hapla and Fusarium oxysporum f. sp. medicaginis on alfalfa. Phytopathology. Accepted Oct. 6, 1987.
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18.001* CRIS0096487
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RICH J R; Agricultural Research Center, Live Dak, **FLORIDA** 32060.
Proj. No.: FLA-LIO-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 86/10 to 87/09. Twenty-eight accessions of pigeonpea were obtained from various parts of the world including India, Puerto Rico, Honduras, and Haiti. Greenhouse tests were initiated to determine relative resistance or tolerance of these accessions to Meliodogyne javanica and M. incognita. Individual plants in 150 cc containers were inoculated with 1500 eggs each of M. javanica or M. incognita. Sixty-five days after inoculation, number of egg masses, and root galling was determined. Df the accesions inoculated with M. javanica, 11 of the 28 exhibited no egg mass production or root galling. Twenty-five accessions of the 28 accessions inoculated with M. incognita exhibited no galling or egg mass production. Test data indicated a range of responses from susceptibility to immunity in pigeonpea to the two nematode species. Further tests under field conditions are necessary to confirm these observations.

Publications: 86/10 to 87/09
NO PUBLICATIDNS REPORTED THIS PERIOD.

18.002* CRIS0134370
EFFICIENT MANAGEMENT OF MULTIPLE-CROPPING, MINIMUM-TILLAGE SYSTEMS

GALLAHER R N; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-AGR-02563 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine multiple-cropping and minimum-tillage system combinations for year-round crop production. Determine soil fertility, chemistry, and physics; cultural aspects of the crops; tillage; pest; and equipment management.

Approach: People in Florida and the southeast are more aware today than ever before that multiple cropping aids in efficient utilization of expensive farming resources. Research studies will be conducted in the following areas: nitrogen and potassium fertilization of a no-tillage rye-soybean, double cropping system, soil fertility, chemical, and physical properties affected by time, location, cropping system, and tillage, etc. Soil will be collected from long-term studies from other locations outside of Florida for comparison with Florida data.

Progress: 88/01 to 88/09. Crop yields are often reduced by nematode infestations. Dne study was completed that determined the effect of two double cropping systems under two tillage systems on infestation of four nematode species. The vetch/corn cropping system increased the root-knot nematode population by 290% compared to the vetch/grain sorghum double cropping system. In contrast, the vetch/grain sorghum sequence increased the ring nematode population by 65% compared to the vetch/corn cropping system. Conventional and no-tillage treatments were equally infested by nematodes. In another oat/soybean double cropping study total soybean and oat root dry weight was equal for both conventional and no-tillage treatments aftter 10 years of tillage and cropping history. However, no-tillage had more root dry weight (79% of the total) in the upper 10 cm soil layer for soybean and in the upper 5 cm (85% of the total) for oat, as compared to the conventional treatment. This high concentration of roots near the soil surface in no-tillage has implications for management of fertilizer and water for no-tillage double cropping systems.

Publications: 88/01 to 88/09
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ORTIZ, R.A. 1988. Nitrogen and potassium fertilization of a no-tillage rye-soybean double-cropping system. Ph.D. dissertation, Agronomy Dept., IFAS, Univ. of FL,

Gainesville, FL 32611.
VAZQUEZ, L., MYHRE, D.L., GALLAHER, R.N., HANLON, E.A. and PORTIER, K.M. 1988.

18.003* CRIS0096490
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

OVERMAN A J; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 33508.
Proj. No.: FLA-BRA-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: Investigation of the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops grown in Florida and evaluation of management strategies designed to reduce economic losses due to nematodes attacking agronomic crops.

Approach: In minimum tilled or tilled field plots, nematode populations will be evaluated on various crop sequencing tests. Nematicides and soil-fumigants will be used to determine effect of nematodes and/or soil-borne diseases on crop production potential.

Progress: 87/10 to 88/09. A RCB design of 52 6m x 9.9 m-plots were established in a 10 year Bahia grass pasture in December 1987. Factors tested in the split plot design over a period of 3 years will be fertilizer (336 kg ha-), nematicide carbofuran (2.24 kgai ha-) and seeding of white clover (4.5 kg/ha) cvs. Osceola + Las-1 in all combinations with controls. All treatments were established in December. Furadan was applied only once. Nematode population estimates made during 12 months following treatment indicate that Hemicycliophora is the most abundant genus in the soil followed by Dolichodorus. In general, no striking nematode differences have occurred due to use of carbofuran.

Publications: 87/10 to 88/09
MISLEVY, P., et al. 1988. 'Florona' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).
MISLEVY, P., et al. 1988. 'Florico' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

18.004* CRIS0096486
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RHOADES H L; Central Fla Res & Ed Center; University of Florida, Sandford, **FLORIDA** 32771.
Proj. No.: FLA-SAN-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of plant nematodes associated with certain agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicides in field studies and evaluate according to yield phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 85/10 to 86/10. The sting nematode, Belonolaimus longicaudatus, and the lance nematode, Hoplolaimus galeatus, were placed alone and in combination on field corn, Zea mays. Both nematodes increased to high populations when alone, but in concomitant populations, the sting nematode reproduced rapidly and built up to a population essentially the same as when alone, whereas the lance nematode increased to only approximately 50% of its population when alone. Injury to the corn was much more severe from the sting nematode. Populations of the sting nematode were high following summer cover crops of sorghum-sudangrass (Sorghum bicolor X S. sudanense), cowpea (Vigna sinensis), and a natural growth of weeds, but were low following cover crops of hairy indigo (Indigofera hirsuta) and jointvetch (Aeschynomeme americana) and soil fallow.

Publications: 85/10 to 86/10
NO PUBLICATIONS REPORTED THIS PERIOD.

18.005 CRIS0142342
INTEGRATING CONSERVATION TILLAGE & PEST MANAGEMENT WITH IRRIGATED COTTON, SOYBEAN AND TRITICALE

DOWLER C C; JOHNSON A W; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 0500-21010-002-29D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 87 to 30 SEP 91

Objectives: To utilize irrigation application technology with new and improved integrated pest management systems for controlling weeds, nematodes, insects, and diseases in a multiple-cropping system of triticale-cotton-soybean grown under irrigated conservation tillage.

Approach: Multiple-cropping sequences of triticale-soybean, triticale-cotton or triticale-cotton-triticale-soybean will be studied. Experiments will integrate optimum and minimum pest management levels on the sequences grown in conservation tillage, and measure the allelopathic and residue management factors of triticale, cotton, and soybean. Soil pest population dynamics will be studied. Irrigation application technology will be utilized to apply crop production materials. Economic profitability, mathematical programming, and simulation models will be developed.

Progress: 87/10 to 87/12. Four tillage treatments (ridge-plant, no-till, row-till, deep-turn) were established on a winter crop of triticale following cotton. Yields of triticale from deep turn plots were 22% greater than yield from ridge-plant plots. Following triticale harvest, the residue was mowed tall (61 cm), mowed short (20 cm), or burned. Cotton (McNair 235) was planted in plots with the four tillage treatments. Yields from plants in deep-turn, row-till, and ridge-plant plots were 27%, 13%, and 7% greater, respectively, than yield from no-till plots. Triticale and cotton yields were affected by previous intensive cropping systems. Yield of cotton and nematode population densities were not affected by triticale residue management. Fenamiphos in combination with fluometuron or metribuzin increased injury to cotton and soybean, respectively. Irrigation application technology was successfully used to apply fertilizer, herbicide, nematicide, and insecticide.

Publications: 87/10 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

18.006 CRIS0099920
INTEGRATING CONSERVATION TILLAGE INTO PEST MANAGEMENT LEVELS WITH CROP PRODUCTION SYSTEMS

JOHNSON A W; Plant Pathology; University of Georgia, Tifton, **GEORGIA** 31794.
Proj. No.: GEO-02-0227 Project Type: STATE
Agency ID: SAES Period: 01 OCT 86 to 30 SEP 89

Objectives: Develop integrated pest management systems utilizing conservation tillage in crop production systems in the Southeastern Coastal Plain.

Approach: Three cropping sequences of soybean, cotton, and triticale (1-year double cropping sequence of soybean-triticale; 1-year double cropping sequence of cotton-triticale; and a 2-year cycle of cotton-triticale-soybean-triticale) will be established under conservation tillage (at least 30% of the preceding crop residue will be maintained at or near the soil surface), irrigation, and optimum and minimum pest management levels. Nematode population densities, root-gall indices, soil-borne pathogens, weeds, and insects will be monitored on monthly or other predetermined schedules. Crop response parameters such as stand, growth characteristics, quality, and yield will be measured. The research will be conducted in cooperation with plant pathologists, horticulturists, weed scientists, agronomists, entomologists, agricultural engineers, pesticide residue chemists, and economists.

Progress: 87/01 to 87/12. Ridge-plant, no-till, row-till and deep-turn tillage treatments were established on triticale (T) following cotton (C). Yields of T from deep-turn, row-till, and ridge-plant were 24%, 13%, and 2% greater, respectively, than yield from no-till treatment. After harvest of T, the stubble residue was mowed tall (60 cm), mowed short (20 cm), or burned. C 'McNair 235', resistant to Meloidogyne incognita, was planted on tillage treatments as described for T. Numbers of spiral nematodes, Helicotylenchus dihystera, ranged from 145 to 775/150 cm soil on T and 145 to 1100/150 cm on C, but were not affected by tillage methods or residue management. Three cropping systems, T-C; T-soybean (SB); and T-C-T-SB were established under irrigation and optimum (fenamiphos

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

18.007* CRIS0131303
IDENTIFICATION, BIOLOGY, AND MANAGEMENT OF AGRICULTURALLY IMPORTANT PLANT PARASITIC NEMATODES

MCGAWLEY E C; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02587 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 SEP 91

Objectives: To identify nematode genera, species, and races parasitic on major Louisiana crop plants. To evaluate the influence of other major plant pest groups on nematode population ecology and pathogenicity. To investigate methods useful in reducing nematode-related plant injury.

Approach: Nematode survey, greenhouse host differential testing for nematode race identification, light microscopy of nematode and plant characteristics. Field plot experiments, microplot research. Laboratory, greenhouse, and field experimentation with natural and synthetic nematicides.

Progress: 87/01 to 87/12. In numerical order, with the frequency of detection indicated in parentheses immediately after, the distribution of the five known races of the Soybean Cyst Nematode (as represented by 162 soil samples collected from the 13 major soybean producing parishes) in Louisiana is as follows: race 1 (7); race 2 (24); race 3 (68); race 4 (30); race 5 (15) and, questionable race (18). Results of greenhouse studies conducted to assess the interaction or lack thereof between the Soybean Cyst Nematode and the Red Crown Rot disease pathogen, Calonectria crotalariae, indicates that the reproduction f each organism is augmented in the presence of the other. Disease effects are additive. Penetrsation of root tissues of cyst nematode resistant plants is significantly increased when it is infected with the fungus. Race 2 of Meloidogyne incognita (Mi-2) is the most common one associated with soybeans in Louisiana. Cultivars which contain resistance to this nematode are available. Cultivars with resistance to Mi-2, but which are severely galled have been observed under field conditions with increasing frequency during the last two years. These cultivars contain both Mi-2 and M. iavanica.

Publications: 87/01 to 87/12
OVERSTREET, C. and MCGAWLEY, E.C. 1987. Influence of Calonectria crotalariae on reproduction of Heterodera glycines on

resistant and susceptible soybeans. Journal of Nematology. (In press).
RUSSIN, J.S., LAYTON, M.B., BOETHEL, D.J., MCGAWLEY, E.C. SNOW, J.P. and BERGGREN, G.T. 1987. Interactions of Heterodera glycines with Diaporthe phaseolorum var. caulivora and insect-induced defoliation on soybean.
RUSSIN, J.S., LAYTON, M.B., MCGAWLEY, E.C. BOETHEL, D.J. and SNOW, J.P. 1987. Interactions between soybean looper, stem canker fungus, and soybean cust nematode on soybean. Phytopathology 77: (In Press).
LAYTON, M.B., RUSSIN, J.S., MCGAWLEY, BOETHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Effects of insect-induced defoliation, stem canker disease, and soybean cyst nematode on soybean growth and N(2) fixation.
MCGAWLEY, E.C. and WINCHELL, K.L. 1987. Greenhouse reproduction of single and combined Meloidogyne incognita and M. javanica on soybean. Journal of Nematology 19: (In Press).

18.008* CRIS0074948

INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL01306 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs. Determine the relationships among initial nematode population densities and crop yields, and impact of biotic and abiotic stresses on these relationships. Develop and validate predictive crop loss assessment systems. Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Laboratory, tissue culture, system science, growth chamber, greenhouse and field research procedures will be used to evaluate the associations between Pratylenchus penetrans and Solanum tubersum, and Heterodera schachtii and Brassica capitata relation to the four objectives of this project.

Progress: 87/01 to 87/12. During the past several years major research emphasis has been placed on the development of chemigation technology for use by Michigan potato growers. This has now expanded to the muck vegetable, strawberry and ornamental industries. In general on mineral soils, 25 gal/A of metham (sodium N methyl dithiocarbamate) will provide control of Pratylenchus penetrans; whereas, 40-60 gal/A is required for control of the early-die disease complex, and 75-100 gal/A for Verticillium dahliae control. In a three-year potato rotation, only the 100 gal/A rate kept populations of both P. penetrans and V. dahliae at low enough population densities to provide early-die control for a second potato crop. The Michigan geographical isolate of Herodera glycines reproduces on dry beans, and appears to be pathogenic. Heterodera carotae was recovered from 50% of the commercial fields and 19% of the samples in a western Michigan carrot survey. The biology of the MI geographical isolate appears to differ from that reported in the European literature. Meliodogyne nataliei can still be detected in isolated areas of the type location. The Michigan geographical isolate of Heterodera avenae is only mildly pathogenic on local oat and wheat cultivars.

Publications: 87/01 to 87/12

BIRD, G.W. 1987. Role of Nematology in Integrated Pest Management. pp. 114-121 (In) Vistas on Nematology, J. Veech and D. Dickinson (Eds). Society of Nematologists. 509 pp.
BIRD, G.W. 1987. Alternative futures of agricultural pest management. Amer. J. Alt. Agric. 2:25-29.

19.001* CRIS0072312
PARASITIC NEMATODES OF RANGE AND PASTURE: IDENTIFICATION, PATHOGENICITY AND CONTROL

MAGGENTI A R; Nematology; University of California, Oavis, **CALIFORNIA** 95616.
Proj. No.: CA-O*-NEM-3494-H Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To gain an understanding of the biology and ecology of plant-parasitic nematodes on dry range and irrigated pasture, elucidate the amount of range and pasture plant reduction that can be attributed to nematodes, to determine the role plant-parasitic nematodes play in plant succession, to determine the role of soil evolution on the distribution and pathogenicity of nematodes in undisturbed coastal rangelands.

Approach: Survey major California range and pasture areas for plant-parasitic nematodes, collect soil and plants from the five terraces (ea. 100,000 years old) of the geologic staircase at Jughandle State Park, Mendocino County and correlate soil and plant samples with kinds of nematodes recovered.

Progress: 87/01 to 87/12. Four papers concerning nematodes found in California range and pasture land have been published in refereed journals. Two of these were on nematodes living on Bulrush under aquatic conditions. One is on the subject of the development of rootknot. The fourth study is directed to Anguina amsinckiae that is being studied as a potential biological control agent of Amsinckia spp. (fiddleneck) in the southern coast ranges of California. In addition to these papers published, there are two papers accepted for publication on two new species of Gracilacus; one on coastal redwood trees, and the other from spodosolic soil with a pH of 3.8; the host plant was Juneus enifolius (Pursh). The identification of the plant-parasitic and free-living nematodes of the coastal low pH spodosolic soils continues. Two plant-parasitic nematodes have been discovered living in roots of Bulrush (Scirpus robustus) growing in a freshwater coastal stream. Finding Hirschmanniella under such conditions was not unexpected; finding Meloidogyne (rootknot nematode) was. It seems that rootknot nematode attacks when the water is low and then can survive by being protected by the root tissue. Common fiddleneck (Amsinckia intermedia) is a winter annual weed widespread in small grains, alfalfa, pastures and rangelands. Economic concern stems from the fact that is sufficient quantities it can cause liver damage to range animals. A nematode, Anguina amsinckiae attacks the seed heads of fiddleneck thus reducing seed production.

Publications: 87/01 to 87/12

ABDEL-RAHMAN, F. and MAGGENTI, A.R. 1987. Hirschmanniella pomponiensis n. sp. (Nemata: Pratylenchidae), parasitic on Bulrush, Scirpus robustus Pursh. J. Nematol. 19:147-151.
ABOEL-RAHMAN, F. and MAGGENTI, A.R. 1987. Meloidogyne californiensis n. sp. (Nemata: Meloidogyninae), parasitic on Bulrush, Scirpus robustus Pursh. J. Nematol. 19:207-217.
ABOEL-RAHMAN, F. and MAGGENTI, A.R. 1987. Embryonic and postembryonic development of Meloidogyne californiensis Abdel-Rahman & Maggenti, 1987. J. Nematol. 19:505-508.
PANTONE, D.J., GRIESBACH, J.A. and MAGGENTI, A.R. 1987. Morphometric analysis of Anguina amsinckiae from three host species. J. Nematol. 19:158-163.

19.002* CRIS0140426
ARTHROPODS & PLANT PATHOGENS AS BIOLOGICAL AGENTS TO CONTROL SPURGE, YELLOW STARTHISTLE, & KNAPWEEDS

ANDRES L A; TURNER C E; JURD L; Natural Products Chemistry Research Unit; Western Regional Res Center, Albany, **CALIFORNIA** 94710.
Proj. No.: 5325-24000-003-000
Project Type: INHOUSE
Agency IO: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Improved comprehension of the relationship between weeds, their environmentand their natural enemies and the use of this information towards improved management of leafy spurge, yellow starthistle , knapweeds and other introduced weeds on range, pasture and crop areas.

Approach: Discover, study, implement and evaluate new and indigenous natural enemies of those weeds naturalized to N. America. Discovery will be via literatureand museum records and field surveys. Studies will include tests and observations on the biology and behavior of candidate agents in foreign anddomestic laboratory, quarantine and field areas to determine each organism's host specialization, adaptability and potential safe use for weed control in N. America. Those found safe to be introduced to the U.S. will be colonized and distributed to weedy areas and their impact evaluatedBasic studies will be carried out on how insects and plant pathogens find, damage and stress their host plants. Host selection behavior studies and tdhe the fixity of the natural enemy host relationship will be carried out with weeds as well as on economic and non-economic non-target plants. Weeds to be investigated include leafy spurge, yellow starthistle, and knapweeds.

Progress: 87/01 to 87/12. Knapweeds: Releases of the root feeding moths, Agapeta zoegana and Pterolonche inspersa ex Austria/Hungary were made against diffuse and spotted knapweeds in OR, WA. A. zoegana from USSR was released in WA. The nematode, Subanquina picridis, (against Russian knapweed) formed galls on most Centaurea spp. tested, some on artichoke and none on safflower. Field bindweed: First US release of the moth, Tyta luctosa in OK and TX. The eriophyid, Aceria convolvuli, was cleared for US release. Yellow starthistle: The seed weevil, Bangasternus orientalis is established in CA and IO. New releases made in CA, OR and WA. The seed fly, Chaetorellia hexachaeta, failed to survive on safflower or cornflower in lab tests. Leafy spurge: First US release of root beetle, Aphthona czwalinae in MT. The tip gall midge,

Bayeria capitigena and the beetle, Aphthona flava are established in MT and NO. US release made of large numbers A. flava, cyparissias and czwalinae. Survey of spurge in China revealed organisms of high biological control potential. Musk thistle: Overall 50% annual reduction of seed CA by the seed weevil, Rhinocyllus conicus.

Publications: 87/01 to 87/12

PEMBERTON, R.W. and G. JOHNSON. 1987. Aphthona cyparissiae (Coleop: Chrysomelidae) a new flea beetle for leafy spurge control in the U.S. Proc. of the 1986 Leafy Spurge Annual Meeting, July, Riverton, WY, pp. 42-48.

PEMBERTON, R.W. 1988. Myrmecochory in the introduced rangeweed leafy spurge. Amer. Midland Naturalist. (In press July, 1987).

TURNER, C.E., R.W. PEMBERTON & S.S. ROSENTHAL. 1987. Host utilization of native Cirsium thistles (Asteraceae) of the introduced weevil Rhinocyllus conicus (Coleoptera: Curculionidae) in CA. Environ. Entomol. 16:111-115.

TURNER, C.E., R.W. PEMBERTON & S.S. ROSENTHAL. 1987. Host range and new host records for the plume moth Playtptilia carduidactyla (Lepidoptera: Pterophorida from CA thistles (Asteraceae) Proc. Entomol. Soc. Wash. 89:132-1326.

ROSENTHAL, S.S., S.L. CLEMENT, N. HOSTETTLER, & T. MIMMOCCHI. 1988. Biology of Tyta luctuosa (Lep.: Noctuidae) and its potential value as a biological control agent for the weed Convolvulus arvensis. Entomophaga 33: In Press.

19.003* CRIS0132201

BIOLOGICAL CONTROL OF PEST MOLE CRICKETS

FRANK J H; WALKER T J; BOUCIAS D G; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02636 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To improve methods for laboratory culture of the mole crickets Scapteriscus vicinus and S. acletus. To complete evaluation of the effectiveness of the Uruguayan strain of the parasitic nematode Neoaplectana carpocapsae as a biological control agent of Scapteriscus mole crickets, and to develop economically feasible field application methods. To complete evaluation of the effectiveness of the parasitic wasp Larra bicolor as a biological control agent of Scapteriscus mole crickets, and to investigate other Larra species. To perform laboratory and field evaluations of fungal, viral, and microsporidan pathogens of mole crickets.

Approach: To devise a method for successful laboratory colonization and evaluate production of the tachinid fly Euphasiopteryx depleta. To study the life cycle of as many species of the bombardier beetle genus Pheropsophus as possible in quarantine, and to determine which, as larvae, are specialized predators of mole cricket eggs.

Progress: 87/10 to 88/09. The parasitic nematode (Neoaplectana sp., Steinernematidae) from Uruguay which was first released in Florida in 1985 continues to suppress mole cricket populations at the sites of release. It has turned up at a control site >1 km from a release site, presumably spread there by infected mole crickets. Results of field studies at Ft. Lauderdale, Florida, where the parasitic wasp Larra bicolor (Hymenoptera: Sphecidae) has been established since 1981, show that the wasp parasitizes Scapteriscus abbreviatus in the field, with no evidence of parasitism of S. acletus or S. vicinus. An iridovirus detected in Scapteriscus acletus in southern Brazil where it was causing an epizootic has characteristics which do not match those of any described iridovirus. No iridovirus has been reported previously from an orthopteran host, and this one is a potential biocontrol agent for mole crickets if it proves to be safe to non-target organisms. Adult females of the parasitic fly Euphasiopteryx depleta (Diptera: Tachinidae) were trapped in southern Brazil routinely from mid-October 1987. Some of the flies were carried to a quarantine facility in Florida in November 1987 where larvae dissected from them were inoculated onto mole crickets. Many of the larvae developed successfully and some of the resultant adults mated successfully in the laboratory for the first time. Over 200 puparia of a following generation were released in Alachua Co., Florida, in late April 1988, and over 200 at the beginning of June.

Publications: 87/10 to 88/09

BOUCIAS, D.G., MARUNIAK, J.E. and PENOLAND, J.C. 1987. Characterization of an iridovirus isolated from the southern mole cricket, Scapteriscus vicinus. J. Invert. Pathol. 50: 238-245.

CASTNER, J.K. 1988. Biology of the mole cricket parasitoid Larra bicolor (Hymenoptera: Sphecidae) (p. 423-432 in) GUPTA, V.J. (ed.) Advances in parasitic Hymenoptera Research, 1988. Brill, Leiden (in press).

FOWLER, H.G. 1987. Field behavior of Euphasiopteryx depleta (Diptera: Tachinidae): phonotactically orienting parasitoids of mole crickets (Orthoptera: Gryllotalpidae: Scapteriscus). J. New York Ent. Soc. 95: 474-480.

FOWLER, H.G. 1987. Field confirmation of the phonotaxis of Euphasiopteryx depleta (Diptera: Tachinidae) to calling males of Scapteriscus vicinus (Orthoptera: Gryllotalpidae). Florida Ent. 70: 409-410.

FRANK, J.H. and SMART, G.C. 1988. The parasitic nematode Neoaplectana n. sp. as a biological control agent of mole crickets (p. 25-29 in) Report of turfgrass research supported by the FTGA 1987-1988. Univ. Florida, IFAS, i + 47 p.

19.004 CRIS0142262
BIOLOGICAL CONTROL OF MOLE CRICKETS IN THE SOUTHEAST

LYNCH R E; FRANK J H; HUDSON W G; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: 6602-24000-001-04S
Project Type: CDDPERATIVE AGREE.
Agency ID: ARS Period: 15 JUL 87 to 30 SEP 88

Objectives: Conduct research on Scapteriscus spp. that damage turf, forage, and row crops in the southeast to develop laboratory techniques and procedures for rearing mole crickets. Determine seasonal life history as affected by reproductive and developmental biology. Delineate the nature and extent of damage to various crops by mole crickets. Evaluate biological control agents for control of mole crickets.

Approach: Study the reproductive behavior and developmental biology of Scapteriscus spp. in the southeast and define seasonal occurrences. Conduct research to define survival, longevity, fecundity, and developmental biology of mole crickets reared in the laboratory on various artificial and natural diets. Evaluate establishment of Larra bicolor in various habitats and its controlof mole crickets. Evaluate nematodes for infectivity and control of mole crickets. Evaluate predators for control of mole crickets.

Progress: 87/07 to 87/12. The infectivity of the Uruguayan strain of Neoaplectana carpocapsae for Scapteriscus vicinus was studied in soil-filled boxes under controlled temperature and humidity conditions in the laboratory. Mole crickets with a pronotal length <3 mm were not infected by the nematode. There was no difference in the proportion of mole crickets infected for those with a pronotal length >4 mm. Infection of largest nymphs was about one-third that found for adults, even though they were little smaller than adults. These data confirm results noted in the field where numphs of all sizes are infected much less frequently than are adults. Studies were also conducted on Pasimachus sublaevis, a ground beetle that feeds on mole crickets. Adults of these beetles are found in substantial numbers in pitfall traps used to collect mole crickets. The adults are voracious predators of mole crickets. All stages of the beetle have been reared in the laboratory. Rearing data are being compared with ovariolar dissections of adult female beetles to determine seasonality of reproduction.

Publications: 87/07 to 87/12
HUDSON, W.G., and SAW, J.G. 1987. Spatial distribution of the tawny mole cricket, Scapteriscus vicinus. Entomol. Exper. et Applicata 45:99-104.
HUDSDN, W.G. 1987. Variability in development of Scapteriscus acletus (Drthoptera: Gryllotalpidae). Fla. Entomol. 70:403-404.
KHUONG, N.B., and SMART, G.C. 1987. In vitro and in vivo culture of a neoaplectanid nematode from mole crickets. Proc. Soil Crop Sci. Soc. Fla. 46:147.

19.005* CRIS0096488
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

KINLDCH R A; Agr Res Cntr; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 88/01 to 88/12. Winter planting of Cahaba White vetch, Vantage Purple vetch, ryegrass, and wheat were not significantly different from winter fallow in their effects on the soil infestation levels of the rootknot nematode Meloidogyne incognita and on subsequent galling and yields of rootknot susceptible (Hartz 7126) and resistant (Hartz 7110) soybean cultivars. Galling and yield of the susceptible cv over all winter treatments were 2.7 (on a scale of 0-4) and 1228 kg/ha; whereas those of the resistant cv weere 0.1 and 2269 kg/ha. Field studies were initiated to study the influence of summer planted crops (soybean, sorghum, maize, alyceclover, millet, sorghum X sundangrass, lespedeza, hairy indigo, peanut, aeschynomene, and cotton) on the abundance of Meloidogyne arenaria. In evaluations of 34 public and commercial cultivars and breeding lines at a site infested with M. arenaria, yields ranged from 111 kg/ha (DP 497, galling = 3.8 on a scale of 0-4) to 1591 kg/ha (Asgrow 6785, galling = 1.8). Yield of all cultivars (Y) was related to galling (X) by Y = 2084-475X, r = -0.77 ($P < 0.01$). At a site infested with M. incognita yields ranged from 999 kg/ha (S69-96, galling = 2.6) to 2941 kg/ha (Coker 6847, galling = 0.3). Yield was related to galling as Y = 2691-430X, r = -0.65. At a site infested with the soybean cyst nematode Heterodera glycines (Race 3) yields ranged from 1221 kg/ha (Cobb) to 2793 kg/ha (Coker 6847).

Publications: 88/01 to 88/12
KINLDCH, R.A. 1988. Incidence of nematode trophic groups in a native woodland soil and in adjacent agricultural soil planted to various crops. Proc. Soil Crop Sci. Soc. Florida 47: 249-250.
KINLOCH, R.A. and RODRIQUEZ-KABANA, R. 1989. Rootknot nematode disease. In Compendium of soybean diseases. American Phytopathological Society. (In press).

19.006* CRIS0135108
MAXIMIZING THE UTILITY OF ENTOMOGENOUS PATHOGENS IN CROP PRODUCTION SYSTEMS

GARDNER W A; Entomology; University of Georgia, Griffin, **GEORGIA** 30223.
Proj. No.: GE001419 Project Type: HATCH
Agency ID: CSRS Period: 01 AUG 88 to 31 JUL 91

Objectives: Quantify the impact of agrichemicals, soil antagonists, and target pest movement patterns on the persistence, stability, and efficacy of entomogenous fungi and nematodes in selected soils; determine and analyze biotic and abiotic factors that regulate natural epizootics of entomopathogens; evaluate methods to enhance the activity of the bacterium Bacillus thuringiensis against polyphagous lipidopteran pests; screen and manipulate pathotypes of selected entomogenous fungi to yield isolates resistant to antagonistic agents.

Approach: Laboratory, greenhouse, and field studies will investigate the impact of herbicides and soil microorganisms on the survivorship of entomogenous fungi and nematodes. Beauveria bassiana, Steinernema, and Heterorhabditis will serve as models. Regression procedures will be used to define key factors governing epizootics of entomogenous fungi. Controlled laboratory and greenhouse studies will further delineate the role of environmental factors in their epizootiology. Dose/mortality responses, feeding inhibition, and foliage consumption will be measured in laboratory studies. Field trials of efficacy will follow. Repeated subculturing and induced mutagenesis will be utilized to select for increased resistance of B. bassiana to antagonistic herbicides.

19.007* CRIS0137196
SYSTEMATICS, ECOLOGY, AND PATHOGENIC POTENTIAL OF SELECTED PLANT-PARASITIC NEMATODES IN TENNESSEE

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00916 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 89 to 30 SEP 92

Objectives: To identify and describe, when appropriate, plant-parasitic nematodes of potential economic importance, and correlate distribution and abundance of selected nematode species with vegetation and edaphic factors; to determine effects of selected nematode species on host plants.

Approach: Selected crops or plant associations showing stress, or with the potential for being stressed, will be sampled on a field-by-field basis, by plant associations, or by transect. Two major surveys will be conducted: A) on clover pastures and soybean fields to determine the range of a new root-knot nematode species, and B) in all regions of the Great Smoky Mountains National Park, where some species may be contributing to tree declines. Findings will be correlated with edaphic and vegetation factors by means of similarity indices and computer-assisted cluster analysis. Dorylaimid nematodes in the genera Tylencholaimellus and Dorylaimellus will be reared in the greenhouse on corn. Nematodes will be surface-sterilized, then placed on agar plates containing corn callus or excised roots. Nematodes will be observed for feeding and reproduction. An underscribed root-knot nematode parasitic on clover and soybean will be studied to determine host range, pathology on the root system, effects on nodulation, and quantification of damage.

20.001 CRIS0066991
DISTRIBUTION, PATHOGENICITY AND CONTROL OF NEMATODES PARASITIZING ALFALFA IN CALIFORNIA

MCKENRY M V; FERRIS H; THOMASON I J; Inter Institutional; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-RD-XXX-3123-H Project Type: HATCH
Agency ID: CSRS Period: 11 DEC 74 to 30 SEP 86

Objectives: Measurement of the effect of plant-parasitic nematodes on the growth of alfalfa,and test of promising nematicides, when available, on alfalfa parasitized by nematodes.

Approach: Nematode species in question will be isolated and reared in monoculture. Effects of these species on alfalfa will be compared in microplots to uninfested controls. Microplots will be treated with methyl bromide before infestation. Candidate nematicides will be tested in replicated randomized plots in alfalfa fields naturally infested with nematodes.

Progress: 74/12 to 86/09. Many nematodes are common in California alfalfa and pathogenicity testing was conducted under warm central California climates with dormant and non dormant alfalfa varieties. The following nematode species did not cause damage and did not reproduce well on six alfalfa varieties in sandy loam soil: Merlinius brevidens, Tylenchorhynchus clarus, Meloidogyne arenaria, Meloidogyne incognita and Helicotylenchus dihystera. Two species reproduced well but did not reduce yields over a three-year period including: Xiphinema americanum, and Paratrichodorus minor. Meliodogyne javanica reproduced well and reduced yields of Vernal alfalfa by 25%, but did not reproduce on 5 other alfalfa cultivars. Meloidogyne hapla from central California reproduced on every alfalfa cultivar including Nevada Syn XX which is "resistant" germplasm and reduced long-term yields by at least 15% in all varieties except Nevada Syn XX. M. hapla populations collected from northern California did not reproduce well on Nevada Syn XX but persisted for 3 years. The most common nematodes of northern California are M. brevidens and T. clarus which did not survive well in central California soils. Nematicide treatments with ethoprop resulted in phytotoxicity. Treatment with carbofuran enhanced plant growth for a brief period and reduced nematode populations for several months. Previously reported resistance is generally only tolerance.

Publications: 74/12 to 86/09
NO PUBLICATIONS REPORTED THIS PERIOD.

20.002* CRIS0096487
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RICH J R; Agricultural Research Center, Live Oak, **FLORIDA** 32060.
Proj. No.: FLA-LIO-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 86/10 to 87/09. Twenty-eight accessions of pigeonpea were obtained from various parts of the world including India, Puerto Rico, Honduras, and Haiti. Greenhouse tests were initiated to determine relative resistance or tolerance of these accessions to Meliodogyne javanica and M. incognita. Individual plants in 150 cc containers were inoculated with 1500 eggs each of M. javanica or M. incognita. Sixty-five days after inoculation, number of egg masses, and root galling was determined. Of the accesions inoculated with M. javanica, 11 of the 28 exhibited no egg mass production or root galling. Twenty-five accessions of the 28 accessions inoculated with M. incognita exhibited no galling or egg mass production. Test data indicated a range of responses from susceptibility to immunity in pigeonpea to the two nematode species. Further tests under field conditions are necessary to confirm these observations.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

20.003 CRIS0088972
MELOIDOGYNE SPP. AS LIMITING FACTORS ON N(2) - FIXATION BY FORAGE LEGUME IN THE TROPICS

BALTENSPERGER D D; QUESENBERRY K H; PASLEY S F; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-AGR-02326
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 SEP 82 to 30 SEP 85

Objectives: Identify the major Meloidogyne spp. (root knot nematodes) present in Malawi and demonstrate the degree to which Meloidogyne spp. limit biological nitrogen fixation in forage legumes in Malawi and Florida. Develop optimum procedures which can be used to identify sources of resistance to Meloidogyne spp. Develop forage legume genotypes resistant to M. javanica, M. arenaria, and M. incognita, in order to enhance BNF in the legume/rhizobium symbiosis.

Approach: Major Meloidogyne spp. will be identified by growing susceptible crops and classifying larvae collected from these plants. Techniques developed for screening A. americana

will be adapted for use on the other species. Screening will be conducted for each nematode separately in the initial breeding cycles. Effects of nematode resistant germplasm on subsequent maize ccrops will be field tested in Malawi.

Progress: 82/09 to 87/03. A field study was completed to evaluate the interactions of rhizobia numbers and nematode numbers. Resistance and susceptible plant genotypes were grown in nematode infested and non-infested environments (nematicide) with varying levels of additional N and rhizobia inoculum. Indications are that the resistant genotype was higher yielding under nematode infested conditions and averall but not under the uninfested or fumigated situation. Resistance is valuable in reducing root-knot nematode build-up. Florigraze and Arbrook rhizoma peanuts (Arachis glabrata) were evaluated for root-knot nematode resistance compared with alyceclover (Alysicarpus vaginalis). They were both highly resistant with Florigraze being classified as immune to Meliodogyne arenaria, M. javanica and M. incognita. Arachis glabrata appears to be a potential source of resistance to M. arenaria for breeders attempting wide crosses with Arachis hypogea (cultivated peanuts). Hairy indigo genotype interaction with the above root-knot nematodes was evaluated for several plant introductions and Florida collections. Most are as resistant as Florida Common hairy indigo and sources of improved resistance appear to be available.

Publications: 82/09 to 87/03

BALTENSPERGER, D.D., PRINE, G.M. and DUNN, R.A. 1986. Root-knot nematode resistance in Arachis glabrata. Peanut Sci. 13:

TAYLOR, S.G., BALTENSPERGER, D.D., QUESENBERRY, K.H. and DUNN, R.A. 1986. Variability in Meloidogyne resistance within the genus Alsicarpus. Crop Sci. 27:501-505.

QUESENBERRY, K.H., BALTENSPERGER, D.D. and DUNN, R.A. 1986. Screening Trifolium spp. for response to Meloidogyne spp. Crop Sci. 26:61-64.

DOMINGUEZ, H.E., BALTENSPERGER, D.D. and DUNN, R.A. 1987. Hairy Indigo as a root-knot nematode suppressing forage legume. Agronomy Abstracts 79:109.

BALTENSPERGER, D.D., DUNN, R.A. and ANDERSDN, W.H. 1987. Interaction of resistance to root-knot nematodes with forage yield, plant nitrogen status and nematode populations. Agronomy Abstracts 79:104.

20.004* CRIS0134370

EFFICIENT MANAGEMENT OF MULTIPLE-CROPPING, MINIMUM-TILLAGE SYSTEMS

GALLAHER R N; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-AGR-02563 Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 88 to 30 SEP 93

Objectives: Determine multiple-cropping and minimum-tillage system combinations for year-round crop production. Determine soil fertility, chemistry, and physics; cultural aspects of the crops; tillage; pest; and equipment management.

Approach: People in Florida and the southeast are more aware today than ever before that multiple cropping aids in efficient utilization of expensive farming resources. Research studies will be conducted in the following areas: nitrogen and potassium fertilization of a no-tillage rye-soybean, double cropping system, soil fertility, chemical, and physical properties affected by time, location, cropping system, and tillage, etc. Soil will be collected from long-term studies from other locations outside of Florida for comparison with Florida data.

Progress: 88/01 to 88/09. Crop yields are often reduced by nematode infestations. Dne study was completed that determined the effect of two double cropping systems under two tillage systems on infestation of four nematode species. The vetch/corn cropping system increased the root-knot nematode population by 290% compared to the vetch/grain sorghum double cropping system. In contrast, the vetch/grain sorghum sequence increased the ring nematode population by 65% compared to the vetch/corn cropping system. Conventional and no-tillage treatments were equally infested by nematodes. In another oat/soybean double cropping study total soybean and oat root dry weight was equal for both conventional and no-tillage treatments aftter 10 years of tillage and cropping history. However, no-tillage had more root dry weight (79% of the total) in the upper 10 cm soil layer for soybean and in the upper 5 cm (85% of the total) for oat, as compared to the conventional treatment. This high concentration of roots near the soil surface in no-tillage has implications for management of fertilizer and water for no-tillage double cropping systems.

Publications: 88/01 to 88/09

GALLAHER, R.N., DICKSDN, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Effect of tillage and multicropping systems on the population dynamics of phytoparasitic nematodes. Anals of Applied Nematology. Accepted for publication.

ORTIZ, R.A. and GALLAHER, R.N. 1988. Evaluacion economica y respuesta del doble cultivo centeno soja a la aplicacion de nitrogeno y potasio en un sistems de labranza cero. Gaceta agronomica (Buenos Aires, Argentina). VIII (No. 43).

CORELLA, J., GALLAHER, R.N. and DICKSDN, D.W. 1988. Effect of tillage and vetch-corn versus vetch-grain sorghum succession multicropping systems on population dynamics of phytoparasitic nematodes. Agronomy Dept., IFAS, Univ. of FL.

BUSTILLO, J. and GALLAHER, R. N. 1988. Partitioning of dry matter in fall-grown, no-tillage tropical corn in Florida. Agronomy Dept., IFAS, Univ. of FL, Agronomy Res. Rept. AY 88-04.

BRUNIARD, G.C. 1988. Double-cropped soybean/oat root growth and development affected by tillage. M.S. thesis, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.

ORTIZ, R.A. 1988. Nitrogen and potassium fertilization of a no-tillage rye-soybean double-cropping system. Ph.D. dissertation, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.
VAZQUEZ, L., MYHRE, D.L., GALLAHER, R.N., HANLON, E.A. and PORTIER, K.M. 1988.

20.005* CRIS0096489
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

DICKSON D W; DUNN R A; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with field corn, peanut, soybean, and forage crops grown in Florida, and to design and evaluate management strategies to reduce economic losses on these crops.

Approach: The population dynamics and economic damage levels of Pratylenchus brachyurus and Mel Meloidogyne arenaria on peanut and P. brachyurus and Paratrichodorus sp. on corn will be established. The efficacy of fumigant and nonfumigant nematicides for management of nemas on peanut and corn will be investigated. A crop rotation management scheme will be evaluated for managing M. arenaria on peanut. The population dynamics of nemas in minimum tillage-multicropping systems will be monitored. Host-parasite relationships and economic damage relationships of Meloidogyne spp. to soybeans and of various nematodes including Belonolaimus spp. and Meloidogyne spp. to forage crops will be investigated. In cooperative efforts with plant breeders, germ plasm of forage crops, primarily legumes, will be screened for reactions to Meloidogyne spp.

Progress: 87/10 to 88/09. Three tests were conducted to evaluate the efficacy of fumigant and nonfumigant nematicides for control of Meloidogyne arenaria race 1 on peanut. Methyl bromide, 1, 3-D, methyl isothiocyanate, methyl isothiocyanate mixtures, aldicarb, ethoprop, fenamiphos, and F5145 were evaluated by different methods of application preplant, at plant or at early flowering. Of the 32 treatments evaluated, only seven resulted in yield increases (P = 0.05) although early season vigor was high in all treated plots. During the latter one-third of the growing season, however, nematode control was not adequate in most treatments resulting in heavy peg, pod, and root infection by M. arenaria. Four populations of Pratylenchus brachyurus were tested in a greenhouse on selected plant species to determine host suitability and usefulness inidentifying physiological races of the nematode. The differential plants were alfalfa, snap bean, citrus, corn, peanut, soybean, and tomato. Fresh shoot or root weights of plants inoculated with all populations were similar to each other and to the uninoculated control in both experiments. The numbers recovered from snap bean were different (P = 0.05) between populations in each test and from soybean in the second test. The differences between populations on snap bean were different in 2 tests. The effect of two cropping and tillage systems on the population dynamics of 4 nematode species was evaluated.

Publications: 87/10 to 88/09
PAYAN, L.A. and DICKSON, D.W. 1988. Host specificity of four populations of Pratylenchus brachyurus. Ann. Appl. Nematol. 2 'in press'.
GALLAHER, R.N., DICKESON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Tillage and multiple cropping systems and population dynamics of phytoparasitic nematodes. Ann. Appl. Nematol. 2 'in press'.
DICKSON, D.W. and HEWLETT, T.E. 1987. Effect of two nonfumigant nematicides on corn grown in two adjacent fields infested with different nematodes. Ann. Appl. Nematol. 1:89-93.
DICKSON, D.W. and MCSORLEY, R. 1987. Standarization of nematicide application rates. Ann. Appl. Nematol. 1:1-5.
DICKSON, D.W. 1984. Cultural control of nematodes. Pp. 40-45. United States Department of Agriculture, Agricultural Research Service. Nematology Workshop. Oct. 15-18.

20.006* CRIS0142262
BIOLOGICAL CONTROL OF MOLE CRICKETS IN THE SOUTHEAST

LYNCH R E; FRANK J H; HUDSON W G; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: 6602-24000-001-04S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 15 JUL 87 to 30 SEP 88

Objectives: Conduct research on Scapteriscus spp. that damage turf, forage, and row crops in the southeast to develop laboratory techniques and procedures for rearing mole crickets. Determine seasonal life history as affected by reproductive and developmental biology. Delineate the nature and extent of damage to various crops by mole crickets. Evaluate biological control agents for control of mole crickets.

Approach: Study the reproductive behavior and developmental biology of Scapteriscus spp. in the southeast and define seasonal occurrences. Conduct research to define survival, longevity, fecundity, and developmental biology of mole crickets reared in the laboratory on various artificial and natural diets. Evaluate establishment of Larra bicolor in various habitats and its controlof mole crickets. Evaluate nematodes for infectivity and control of mole crickets. Evaluate predators for control of mole crickets.

Progress: 87/07 to 87/12. The infectivity of the Uruguayan strain of Neoaplectana carpocapsae for Scapteriscus vicinus was studied in soil-filled boxes under controlled temperature and humidity conditions in the

laboratory. Mole crickets with a pronotal length <3 mm were not infected by the nematode. There was no difference in the proportion of mole crickets infected for those with a pronotal length >4 mm. Infection of largest nymphs was about one-third that found for adults, even though they were little smaller than adults. These data confirm results noted in the field where numphs of all sizes are infected much less frequently than are adults. Studies were also conducted on Pasimachus sublaevis, a ground beetle that feeds on mole crickets. Adults of these beetles are found in substantial numbers in pitfall traps used to collect mole crickets. The adults are voracious predators of mole crickets. All stages of the beetle have been reared in the laboratory. Rearing data are being compared with ovariolar dissections of adult female beetles to determine seasonality of reproduction.

Publications: 87/07 to 87/12

HUDSON, W.G., and SAW, J.G. 1987. Spatial distribution of the tawny mole cricket, Scapteriscus vicinus. Entomol. Exper. et Applicata 45:99-104.

HUDSON, W.G. 1987. Variability in development of Scapteriscus acletus (Orthoptera: Gryllotalpidae). Fla. Entomol. 70:403-404.

KHUONG, N.B., and SMART, G.C. 1987. In vitro and in vivo culture of a neoaplectanid nematode from mole crickets. Proc. Soil Crop Sci. Soc. Fla. 46:147.

20.007* CRIS0134264

APPLICATION OF POPULATION ECOLOGY IN THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

MCSORLEY R T; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02700 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: To assess and improve the efficiency of methods for extracting nematodes from soil. To develop sampling plans for plant-parasitic nematodes in small plots. To develop damage functions for plant-parasitic nematodes on selected agricultural crops. To determine the impact of selected crops and cover crops on dynamics of plant-parasitic nematodes. To investigate the impact of predators on dynamics of nematodes and their potential for biological control. To investigate the impact of selected nonchemical nematode management techniques, such as solarization, use of resistant or tolerant cultivars, and the cropping systems approach.

Approach: Field plots in sites containing gradients in nematode density will be used to derive damage functions and critical point models of nematode population increase. Taylor's power law will be used in the development of sampling plans.

Progress: 88/06 to 88/10. Work on this project has been initiated within the past several months. Data collected during the 1988 growing season is being used to develop damage functions for the sting nematode, Belonolaimus longicaudatus, on corn and soybean. On each crop, relationships between initial and final populations are being developed for B. longicaudatus, Meloidogyne incognita, Pratylenchus branchyurus, and Criconemella spp. Additional field data collected during 1988 are being used to develop sampling plans for these nematodes in small plots. Plant damage functions and nematode population growth functions have been derived for P. brachyurus on peanut in Queenland, Australia, and integrated into a simple management model for testing during the current growing season.

Publications: 88/06 to 88/10

MCSORLEY, R. and O'BRIEN, P.C. 1988. Application of modelling techniques for integrating management options on peanuts. Australian Nematologists' Newsletter 7(2):15-17.

20.008* CRIS0096486

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RHOADES H L; Central Fla Res & Ed Center; University of Florida, Sandford, **FLORIDA** 32771.

Proj. No.: FLA-SAN-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of plant nematodes associated with certain agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicides in field studies and evaluate according to yield phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 85/10 to 86/10. The sting nematode, Belonolaimus longicaudatus, and the lance nematode, Hoplolaimus galeatus, were placed alone and in combination on field corn, Zea mays. Both nematodes increased to high populations when alone, but in concomitant populations, the sting nematode reproduced rapidly and built up to a population essentially the same as when alone, whereas the lance nematode increased to only approximately 50% of its population when alone. Injury to the corn was much more severe from the sting nematode. Populations of the sting nematode were high following summer cover crops of sorghum-sudangrass (Sorghum bicolor X S. sudanense), cowpea (Vigna sinensis), and a natural growth of weeds, but were low following cover crops of hairy indigo (Indigofera hirsuta) and jointvetch (Aeschynomeme americana) and soil fallow.

Publications: 85/10 to 86/10
NO PUBLICATIONS REPORTED THIS PERIOD.

20.009* CRIS0140217
NEMATODE PATHOLOGY AND MANAGEMENT IN AGRONOMIC CROPS OF THE SOUTHEASTERN COASTAL PLAIN

MINTON N A; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 6602-24000-006-00D
Project Type: INHOUSE
Agency ID: ARS Period: 25 JUN 85 to 25 JUN 90

Objectives: To develop principles and practices of nematode control and management systems for agronomic crops that are economical, energy efficient, and environmentally safe and integrate them with other pest management practices for conventional and conservation tillage systems.

Approach: Maximize nematode control in agronomic crops using resistance rotations, multiple cropping, tillage and chemicals. Determine the interaction of nematodes with other pests in conservation tillage and multiple cropping and integrate with control of other pests to minimize use of chemicals and improve production. Assay soil at different levels in profile to determine rate of nematicide degredation and movement. Utilize laboratory,greenhouse, and field experiments. Obtain population densities of nematodes, fungi and insects, root damage indices, plant vigor ratings, stand counts, plant growth measurements, yield, and product quality. Collect data on peanut for developing peanut production models.

Progress: 87/01 to 87/12. In a double-crop minimum till (MT) experiment, peanut yields were the same following wheat and winter fallow. Moldboard plowed (MBP) plots produced 19% more and % sound mature kernels was greater than in plots planted by the subsoil-plant (SP) method. The nematode Meloidogyne arenaria and the fungus Sclerotium rolfsii were more severe in SP plots than in MBP plots. Also, Temik (3.4 kg ai/ha), the soil fungicide SN84364 (2.2 kg ai/ha), and the combination increased yields 14%, 52% and 81%, respectively. Two formulations of methyl bromide applied without tarp reduced M. arenaria damage and increased peanut yields. The greatest increase of 823 kg/ha occurred for Terr-O-Cide (67 kg ai/ha). Temik (1.7 kg ai/ha) applied postplant to the methyl bromide treated plots increased yields an average of 672 kg/ha. A proprietary nematicide, F5145, reduced M. arenaria damage and increased peanut yields at two rates: 4.9 kg ai/ha, 738 kg/ha and 7.4 kg/ha, 659 kg/ha. Yield differences were not significant when soybean was planted by the SP method in rye stubble and in fallow soil infested with M. incognita. However, cultivar yields were different and Temik (3.4 kg ai/ha) increased yields 61.5%. Host tests and morphological features of a Meloidogyne incognita isolate were not typical for any previously described M. incognita race. Improved nematode, disease and insect control in MT and conventional tillage will increase profits and/or reduce soil erosion which will benefit the producer and consumer.

Publications: 87/01 to 87/12
MINTON, N.A., GOLDEN, A.M., and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.
MINTON, N.A., LEONARD, R.A., and PARKER, M.B. 1987. Concentration of phenamiphos in the profile of a sandy loam soil as affected by tillage and time. J. Nematol. 19:544. (Abstract).
MINTON, N.A., and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. J. Nematol. 19:38-43.
SUMNER, D.R., and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

20.010* CRIS0090950
NEMATODE PATHOLOGY, RESISTANCE AND CONTROL ON FIELD AND FORAGE CROPS

MINTON N A; Plant Pathology; Georgia Coastal Plain Expt Sta, Tifton, **GEORGIA** 31794.
Proj. No.: GEO-02-0218 Project Type: STATE
Agency ID: SAES Period: 01 NOV 83 to 31 OCT 87

Objectives: Study the pathology caused by nematodes and associated organisms infecting plants and integrate nematode controls that may include resistant varieties, chemicals, and cultural practices into systems for control of other pests consistent with cultural practices that minimize the use of chemicals and energy, maximice soil conservation, and improves per unit production.

Approach: Field experiments involving multiple cropping, resistant varieties, winter legumes, cultural practices, and chemicals will be conducted to develop systems of pest control. Greenhouse experiments to determine the interaction of nematodes with other organisms and to evaluate germplasm for nematode resistance will be conducted.

Progress: 83/11 to 87/10. Pratylenchus safaensis was reported in the U.S. (GA) and Meloidogyne graminicola in GA for the first time. Internal stem discoloration in Cobb soybean was more severe in soil infested with Fusarium oxysporum f. sp. tracheiphilum race 1, Belonolaimus longicaudatus and P. brachyurus than with only the fungus. Nematodes (M. arenaria, P. brachyurus), white mold (Sclerotium rolfsii), and insects of peanuts double-cropped after wheat were managed equally well in minimum-tiled (MT) and moldboard plowed (MB) soil. Yields in 9 experiments were increased an average of 5.5% by a nematicide and 13.3% by a soil fungicide + insecticide and MB plots yielded 7.8% more than MT plots. Numbers of M. incognita in soybean were greater in fallowed than in rye plots, but soybean yields were the same. Soybean yields were greater in MT than in MB plots. Ethylene dibromide reduced numbers of nematodes and

increased yields more consistently than did aldicarb and phenamiphos. Crimson clover preceeding irrigated corn planted MT had little effect on M. incognita and Paratrichodorus minor. Phenamiphos at 2.8 kg ai/ha increased corn yields 16%. Hoplolaimus columbus populations were high under crimson clover, hairy vetch, common vetch and rye than in fallowed plots; phenamiphos 2.0 kg ai/ha did not control this nematode in corn planted MT and MB. Soil preparation (MT and MB) in rye stubble had little effect on phenamiphos in the soil profile up to 22 weeks after treatment.

Publications: 83/11 to 87/10

MINTON, N.A. 1986. Impact of conservation tillage on nematode populations. Journal of Nematology 18:135-140.

MINTON, N.A. and CSINOS, A.S. 1986. Effects of row spacings and seeding rates of peanut on nematodes and incidence of southern stem rot. Nematropica 16:167-176.

MINTON, N.A., GOLDEN, A.M. and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.

MINTON, N.A. and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. Journal of Nematology 19:38-43.

SUMNER, D.R. and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

20.011 CRIS0133862
IMPROVING NEMATODE MANAGEMENT IN AGRONOMIC CROPS

MINTON N A; Plant Pathology; Georgia Coastal Plain Expt Sta, Tifton, **GEORGIA** 31794.
Proj. No.: GEO-02-0232 Project Type: STATE
Agency ID: SAES Period: 01 NOV 87 to 31 OCT 92

Objectives: To develop principles and practices of nematode management for agronomic crops and integrate them with other pest management practices to result in economical, energy efficient, and environmentally safe production systems for conventional and conservation tillage.

Approach: Resistant cultivars, rotations, multiple cropping, tillage and chemicals will be utilized. Determine the interaction of nematodes with other pests and integrate nematode control with control of other pests to minimize the use of chemicls and improve production. Field, greenhouse and laboratory experiments will be utilized. Obtain population densities of nematodes, fungi and insects, root damage evaluations, plant vigor ratings, plant stands, plant growth measurements, yield and product quality.

20.012* CRIS0135108
MAXIMIZING THE UTILITY OF ENTOMOGENOUS PATHOGENS IN CROP PRODUCTION SYSTEMS

GARDNER W A; Entomology; University of Georgia, Griffin, **GEORGIA** 30223.
Proj. No.: GED01419 Project Type: HATCH
Agency ID: CSRS Period: 01 AUG 88 to 31 JUL 91

Objectives: Quantify the impact of agrichemicals, soil antagonists, and target pest movement patterns on the persistence, stability, and efficacy of entomogenous fungi and nematodes in selected soils; determine and analyze biotic and abiotic factors that regulate natural epizootics of entomopathogens; evaluate methods to enhance the activity of the bacterium Bacillus thuringiensis against polyphagous lipidopteran pests; screen and manipulate pathotypes of selected entomogenous fungi to yield isolates resistant to antagonistic agents.

Approach: Laboratory, greenhouse, and field studies will investigate the impact of herbicides and soil microorganisms on the survivorship of entomogenous fungi and nematodes. Beauveria bassiana, Steinernema, and Heterorhabditis will serve as models. Regression procedures will be used to define key factors governing epizootics of entomogenous fungi. Controlled laboratory and greenhouse studies will further delineate the role of environmental factors in their epizootiology. Dose/mortality responses, feeding inhibition, and foliage consumption will be measured in laboratory studies. Field trials of efficacy will follow. Repeated subculturing and induced mutagenesis will be utilized to select for increased resistance of B. bassiana to antagonistic herbicides.

20.013 CRIS0134350
FACTORS AFFECTING ADAPTATION OF TALL FESCUE TO THE GULF SOUTH

JDDST R E; QUISENBERRY S S; Agronomy; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02681 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 MAR 88 to 28 FEB 90

Objectives: This project will investigate the benefits imparted to tall fescue plants by the presence of the fungal endophyte, Acremonium cornophialum. The relative importance of insects, disease organisms and nematodes in limiting the adaptation and persistence of fall fescue stands will be evaluated. Relative resistance of endophyte-infected and endophyte-free tall fescue to environmental stresses such as drought and high temperature will also be determined by examining photosynthetic and leaf water potential responses to environmental changes. Chemical deterrents to insect feeding will be isolated.

Approach: Sixty-four 183m blocks of endophyte infected and endophyte-free tall fescue will be established and monitored for insect pressure

and disease incidence throughout the growing season. Control plots will be maintained using carbaryl as required for insect management and triadimefon for disease management. Nematode populations under both endophyte-free and endophyte infected stands will be monitored by sampling each fall. Fescue yield response to insect and disease pressure will be determined by harvesting insect management, disease management and no management plots throughout the growing season. Fall armyworms will be used as a bioassay to determine the presence of feeding deterrents and growth inhibitors in tall fescue forage.

20.014 CRIS0078826
ENTOMOPATHOGENS FOR USE IN PEST MANAGEMENT SYSTEMS

FUXA J R; Entomology; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02034 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To identify, characterize and standardize entomopathogens and entomopathogenic formulations to be used in regional trials of efficacy. To determine and analyze the physical and biotic factors that regulate epizootics of entomopathogens. To establish regional procedures and protocols required to maximize the utility of entomopathogens in pest management systems.

Approach: (Obj. 1) Isolates of Spodoptera frugiperda nuclear polyhedrosis virus (NPV) will be bioassayed for virulence and subjected to restriction endonuclease analysis. Repeated passage of virus in host will be used to select for increased virulence. (Dbj. 3) Mathematical models will be developed for explanation or prediction of NPV epizootics in S. frugiperda populations. This effort will focus on immigration and resistance to disease and will identify specific questions for experimentation. Dispersion, certain abiotic factors, transmission to host in corn, and effects on populations of young insects will be investigated experimentally. (Obj. 4) Cultural methods will be investigated to enhance prevalence of NPV in S. frugiperda infesting pastures and corn. Sampling will be continued at sites where a Brazilian NPV was released for control of Anticarsia gemmatalis.

Progress: 87/01 to 87/12. The nematode Steinernema feltiae was evaluated as a control agent for fall armyworm (FAW), Spodoptera frugiperda, in field corn. A dose of 10 nematodes/acre resulted in 29% infection, whereas 10 nematodes/acre resulted in only 3% infection. Spray appliation of the nematodes in 60 vs. 30 gal. water/acre did not affect % infection. Treatment with nematodes did not reduce FAW numbers compared to control plots, though results were affected by light FAW populations and a tropical storm. Vertical transmission was studied in FAW nuclear polyhedrosis virus (NPV) in order to improve microbial control. Dne group of FAW was fed the LD(50) of the Louisiana NPV, and another the LD(50) of a Puerto Rican isolate. The survivors were reared to the adult stage and mated. The next generation of FAW exposed to the Louisiana isolate had no infected insects, but 1% of the Puerto Rico group were killed by NPV. A subsequent experiment had 3 experimental groups: 1. FAW exposed to a dose of NPV slightly higher than the LD(50); 2. FAW again exposed to the LD(50) of the Puerto Rican isolate; and 3. the same treatment as group 2, except that the eggs of the mated survivors were washed in NaC10 solution. In the F(1) generation, infection rates were 0.4% in Group 1, 1.1% in Group 2, and 0.4% in Group 3. Percentages of infection were based on a total of 6,853 FAW in the 2 experiments; thus, confidence in vertical transmission as a real phenomenon is increasing in spite of the low percentages.

Publications: 87/01 to 87/12

FUXA, J.R. 1987. Ecological considerations for the use of entomopathogens in IPM. Annu. Rev. Entomol. 32:225-251.
FUXA, J.R. and TANADA, Y. (Eds.). 1987. Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. 555 pp.
FUXA, J.R. and TANADA, Y. 1987. Epidemiological concepts applied to insect epizootiology. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 3-21.
FUXA, J.R. 1987. Epidemiological concepts applied to insect epizootiology. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 23-41.
TANADA, Y. and FUXA, J.R. 1987. The pathogen population. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 113-157.
DAIGLE, C.J., BOETHEL, D.J. and FUXA, J.R. 1987. Parasitoids and pathogens of green cloverworm (Lepidoptera: Noctuidae) on an unclutivated spring host (Vicia spp.) and a cultivated summer host (soybean, Glycine max (L.) Merrill).
FUXA, J.R. and YEARIAN, W.C. 1987. Viruses. In C.W. McCoy (Gen. Ed.), Microbial Agents for Use in Integrated Pest Management Systems. An Dverview Emphasizing Research Accomplishments for Regional Project S-135, 1978 to 1983.

20.015 CRIS0134126
IDENTIFICATION AND MANAGEMENT OF ALFALFA DISEASES IN LOUISIANA

CDLYER P D; Red River Research Station, Bossier City, **LOUISIANA** 71113.
Proj. No.: LAB02675 Project Type: STATE
Agency ID: SAES Period: 01 MAR 88 to 28 FEB 93

Objectives: 1. Identify major diseases of alfalfa in Louisiana and their economic importance. 2. Develop management strategies to maximize alfalfa production. 3. Evaluate alfalfa varieties and germplasm produced through cell culture for disease resistance.

Approach: Research will be conducted on small field plots. All disease evaluations will be based on standardized rating schemes. Isolation and identification of pathogens will be performed on standard macribiological media. Pesticides utilized in management strategies will include labeled and unlabeled compounds. Varieties to be evaluated will include those commonly grown in Louisiana, as well as new varieties. Germplasm will also be produced using common cell culture techniques. This germplasm will also be evaluated for disease reaction. All plot designs and data analysis will be conducted using sound statistical methods.

20.016 CRIS0141360
DEVELOP BREEDING SYSTEMS TO ENHANCE BIOLOGICAL EFFICIENCY IN ALFALFA

BARNES D K; Agricultural Exper. Station; Agricultural Research Service, St Paul, **MINNESOTA** 55108.
Proj. No.: 3640-22230-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 31 MAR 91

Objectives: Develop multiple trait selection procedures for increasing the effective- ness of combined biochemical, physiological, and morphological character- istics that affect biological nitrogen fixation (BNF), pest resistance, andplant growth; incorporate these traits into improved germplasm, and estab- lish the importance of these traits to alfalfa persistence and production.

Approach: The project will attack problems as part of an interdisciplinary team. In some situations the breeding project will initiate a bi-directional selec- tion program for new types of morphological or pest resistance traits and produce experimental populations. Those population will be cooperately evaluated with plant physiologists to determine the effect of selection on BNF and associated physiological traits. In other situations the breeding project will follow leads from the plant physiology projects and then co-operatively select for physiological and plant metabolism traits. The breeding project will produce seed of the new experimental populations andthen cooperate in testing those populations for agronomic characteristics and pest resistances. This breeding project is responsible for identifying alfalfa populations that have unique and useful characteristics. The breeding project then cooperates with scientists specializing in forage crop production and utilization to determine what cropping systems will maximize the useful characteristics.

Progress: 87/01 to 87/12. Alfalfa fields infested with root-lesion nematodes (Pratylenchus spp.) were sampled to determine the relationships between nematode numbers in alfalfa roots and quackgrass roots and soil topography. Numbers of root-lesion nematodes in alfalfa and quackgrass roots were correlated (r=0.84, 12 d.f.). Nematode distribution patterns were associated with soil drainage patterns. The greatest nematode numbers were located in areas receiving rainfall runoff. These data provide a basis for sampling nematode populations in fields and for testing nematode resistant germplasms. The nondormant cultivar 'Nitro' was released in 1986 to supply forage and N in one-year alfalfa rotations for the Corn Belt. We determined effects of establishment treatments and cutting managements on Nitro during the seedling year. Seeding year alfalfa herbage and root dry matter and N yields of all cultivars were greater for solo-seeding (with or without herbicides) than for companion crop seeding with nonvernalized winter rye, winter wheat, or spring oats. Root dry matter and N yields of Nitro were often similar to other cultivars with companion crop establishment, but with solo-seeding, Nitro produced 30% greater root yields and 36% greater root N yields than the moderately dormant check. When managed for high quality forage production (harvested three times at bud before fall), Nitro had 28% greater root N and 49% greater total fall plant N yields than the moderately dormant check.

Publications: 87/01 to 87/12

CRALLE, H.T., HEICHEL, G.H., and BARNES, D.K. 1987. Photosynthate partitioning in plants of alfalfa populations selected for high and low nodule mass. Crop Sci. Conf.
JESSEN, D.L., BARNES, D.K., VANCE, C.P., and HEICHEL, G.H. 1987. Variation for activity of nodule nitrogen and carbon assimilating enzymes in alfalfa. Crop Sci. 27:627-631.
SHEAFFER, C.C. and BARNES, D.K. 1987. Forage Crops. p. 217-249. In B.R. Christie (ed.). Handbook of plant science in agriculture, Vol. II CRC Press, Inc., Boca Raton, Florida.
SOCKNESS, B.A. and BARNES, D.K. 1987. Inheritance of red endosperm in alfalfa and its relationship to color, size, and viability of seed. Crop Sci. 27:57-61.
THIES, J.A., BARNES, D.K., PETERSEN, A.D., and DEGENHART, N.R. 1987. Sampling fields for plant parasitic nematodes. Proc. 20th Central Alfalfa Improv. Conf.
p. 21, Urbana, IL.
TRIMBLE, M.W., BARNES, D.K., HEICHEL, G.H., and SHEAFFER, C.C. 1987. Forage yield and nitrogen partitioning responses of alfalfa to two cutting regimes and three soil nitrogen levels. Crop Sci. 27:909-914.

20.017 CRIS0003057
COOL-SEASON FORAGE BREEDING, GENETICS AND SEED PRODUCTION

EHLKE N J; Agronomy & Plant Genetics; University of Minnesota, St Paul, **MINNESOTA** 55108.
Proj. No.: MIN-13-035 Project Type: STATE
Agency ID: SAES Period: 01 JUL 87 to 30 JUN 92

Objectives: Initiate a birdsfoot trefoil breeding program to improve seedling vigor, persistence, pest and disease resistance, herbicide tolerance and nitrogen fixation. (2)

Maintain a research, testing and extension program in northern Minnesota.

Approach: The breeding program will incorporate traditional selection methods, 2n gametes and biotechnology and tissue culture. The research and testing program will include seed production and management, variety evaluation, purification of Park Kentucky bluegrass and extension activities.

Progress: 87/01 to 87/12. Birdsfoot trefoil (Lotus corniculatus L.) populations were developed for selection programs to improve seedling vigor, yield, persistence and pest resistance. An intensive selection program is underway for improved nitrogen fixation and utilization in three diverse sources of germplasm. Populations are being increased in the greenhouse for evaluation in 1988 of growth habit and palatability in sheep trials. A field study to assess nematode damage and identify germplasm sources of resistance in birdsfoot trefoil was seeded in Grand Rapids and Rosemount, MN. Herbicide tolerant birdsfoot trefoil plants have been identified and increased levels of EPSP synthase have been found in the tolerant plants. Festuca and Lolium breeding projects have been initiated to transfer the tolerance to postemergence grass herbicides found in red fescue (Festuca rubra L.) into other grasses through interspecific and intraspecific hybridization. Growth regulator and residue management research has been initiated on reed canarygrass (Phalaris arundinacea L.) in northern Minnesota. Nitrogen sources, rates and time of application is being investigated on timothy (Phleum pratense L.). Variety evaluation for potential seed production was continued on existing trials of Kentucky bluegrass (Poa pretensis L.), timothy and reed canarygrass. New variety trials of timothy and Kentucky bluegrass were seeded in 1987.

Publications: 87/01 to 87/12

EHLKE, N.J. and HILL, R.R., JR. 1988. Quantitative genetics of allotetraploid and autotetraploid populations. Genome 30:0000-0000.

CASLER, M.D., TALBERT, H., FORNEY, A.K., EHLKE, N.J. and REICH, J.M. 1987. Genetic variation for rate of cell wall digestion and related traits in first cut smooth bromegrass forage. Crop Sci. 27:935-939.

EHLKE, N.J., ELLING, L.J. and STIENSTRA, W.C. 1987. Performance of Kentucky bluegrass strains. Minnesota Extension Service Series. AG-MI-0424. 11p.

EHLKE, N.J. and ELLING, L.J. 1987. Performance of timothy strains. Minnesota Extension Service Series. AG-MI-0425. 9 p.

20.018 CRIS0060805

DISEASES AND NEMATODE PESTS OF ALFALFA

THIES J A; WILCOXSON R D; Plant Pathology; University of Minnesota, St Paul, **MINNESOTA** 55108.

Proj. No.: MIN-22-064 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Develop methods to evaluate resistance to Pratylenchus penetrans in alfalfa. Determine interrelationship between P. penetrans and soil-borne pathogens and their effect on biological nitrogen fixation. Determine distribution of plant parasitic nematodes on alfalfa in Minnesota and evaluate control. Evaluate resistance of alfalfa to root and foliar diseases.

Approach: Plant growth parameters and nematode reproduction in seedlings inoculated with P. penetrans will be correlated to determine selection criteria for nematode resistance. Resistance will be classified as to antibiosis, non-preference or tolerance. The relationships of P. penetrans with root rot and wilt pathogens in various combinations will be studied by recording plant weights, nematodes/g root, and root-damage and nodule scores. Soil and root samples from fields having problems with stand establishment and maintenance will be assayed for plant parasitic nematodes. Nematode control methods including cultural practices, chemicals, and resistant cultivars will be studied. Experimental populations, plant introductions, and cultivars will be evaluated for restitance to bacterial wilt, Fusarium wilt, Phytophthora root rot, and fall foliar diseases.

Progress: 87/01 to 87/12. This project continued its long-term cooperation with the Minnesota alfalfa breeding project. Alfalfa populations and cultivars submitted by industry, public institutions, and the Minnesota breeding project were evaluated for resistance to bacterial wilt (150), Fusarium wilt (157) and Phytophthora root rot (161) in field tests at St. Paul and Rosemount, Minnesota. Plant introductions comprised 175 of the entries in the bacterial wilt and Fusarium wilt nurseies. A goal of this project is to develop rapid methods for evaluating alfalfa germplasm for resistance to the root-lesion nematoe, Pratylenchus penetrans. Shaker and staining methods were compared for estimating nematode populations and determining optimal sampling time after nematode inoculation for evaluating resistance to P. penetrans in alfalfa. Alfalfa populations Baker, WL-219, MN GRN-2 and MN GRN-4 were inoculated with 29 P. penetrans/plant and grown at 25C. Plants were sampled for root and shoot traits and for nematode numbers 2, 4, 6, and 8 weeks after inoculation. Differences among alfalfa entries were nonsignificant. Shoot and root weights and root damage scores increased with sampling data. Numbers of nematodes and eggs/g fresh root were laregest 6 weeks after inoculation. The staining method indicated 228 and the shaker method 120 nematodes/g fresh root. Staining is a more efficient, reliable method for estimating root populations of P.

Publications: 87/01 to 87/12

THIES, J.A., BARNES, D.K., PETERSEN, A.D. and DEGENHART, N.R. 1987. Sampling alfalfa fields for plant parasitic nematodes. p. 21 In: Proc. Twentieth Central Alfalfa Improvement and Conference. Champaign-Urbana, Illinois (Abstr.) 47 p.

THIES, J.A., BARNES, D.K., RABAS, D.L. and NYVALL, R.F. 1987. NCR-138 Committee (Alfalfa Diseases) Report. p. 38 In: Proc. Twentieth Central Alfalfa Improvement Conference. Champaign-Urbana, Illinois. 47 p.

THIES, J.A. 1986. Root-lesion nematode injury in alfalfa. pp. 125-126. In: 1987 Minnesota Pesticide Recommendations & Applied Research Reports and Proceedings of the 1986 Soils, Fertilizer and Agricultural Pesticides Short Course.

20.019 CRIS0143037

BIOLOGY AND ECOLOGY OF VIRUSES, FUNGI, AND NEMATODES ON FORAGE LEGUMES IN THE HUMID SOUTH

ROWE D E; MCLAUGHLIN M R; PRATT R G; Agricultural Research Service, Mississippi State, **MISSISSIPPI** 39762.
Proj. No.: 6406-22240-005-00D Project Type: INHOUSE
Agency ID: ARS Period: 24 MAY 88 to 23 MAY 93

Objectives: Determine and characterize those pathogens and complexes of pathogens that negatively impact yield and persistence of forage legumes. Determine the interactions of nematodes, fungi, and viruses in the spread and developmentof disease and on the yield of clovers sown in pure stands and with grasses. Develop strategies to manage pathogens and hence the disease they cause.

Approach: Diagnostic applications of broad and narrow spectrum systemic pesticides are applied to clovers and compared to controls in a search of unidentifiedorganisms or complexes causing disease. A survey will be made for nematodesparasitic on clovers. The economical effects of nematodes singularly and incombination with Fusarium will be determined on the clovers. The stability of resistance to Fusarium in the presence of nematodes will be measured. Aphid transmitted viruses and their effects on the clover persistence and yield will be measured. The transmission of luteovirus with the pea aphid will be characterized. The effects of peanut stunt virus and root knot nematodes applied singularly and together will be measured on growth of white clover. Similarly, the effects of Fusarium and three nematodes species, singularly and in combinations will be determined on crimson clover. Field planting dates will be varied to control nematodes and invitro measures of disease resistance will be correlated with invivo measures.

20.020 0150445

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

NIBLACK T L; Plant Pathology; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00287-1 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 93

Objectives: Determine the variability in nematode-host interactions; determine the relationships among host, abiotic factors, and crop losses caused by plant-parasitic nematodes.

Approach: Standard methods will be employed for nematode collection, processing, identification, and enumeration, and reporting. Statistical methods will be appropriate to the experimental designs. Field plots in five locations naturally infested with soybean cyst nematode (SCN) will be used to gather data for investigating environmental effects on variability in SCN-soybean interactions. Two of the same sites will be used for SCN overwinter survival studies. Field microplot, minirhizotron, and microelectrode technology will be employed for investigation of rhizosphere interactions between SCN and soybean lines. Soil samples submitted through extension for analysis will allow qualitative characterization of nematode-host variability in Missouri.

20.021* CRIS0027934

PLANT DISEASE SURVEY AND SPECIAL INVESTIGATIONS

WYSONG D S; WATKINS J E; BOOSALIS M G; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-21-001 Project Type: STATE
Agency ID: SAES Period: 01 JUL 66 to 13 MAR 89

Objectives: Monitor plant disease occurrence; determine casal agents of new diseases; deliniate geographic distribution of new and recurring diseases on a periodic basis; make preliminary studies on severity of new or certain recurring diseases; develop judments on feasibility of short-term versus long-term investigations on certain diseases.

Approach: Conduct periodic field examinations for diseases on field crops with particular attention to alfalfa, corn, sorghum, soybeans and wheat; record and maintain records of pathogen identification, disease severity and location, host, and other pertinent data; conduct further study of specific plant diseases collected on survey; study applicability of practical control measure for economically important diseases.

Progress: 87/01 to 87/12. SOYBEANS: A soybean cyst nematode (SCN) survey was conducted in an 8-county area bordering the Missouri River between Richardson County on the south and Burt County on the north. A total of 130 soybean fields were included in the survey, which was initiated in late July and completed in mid-August, 1987. Assays of soil and plant roots collected on survey resulted in the identification of 13 "new" infested fields. The number of fields surveyed by county and the number of confirmed SCN fields (in parentheses) is as follows: Richardson - 20 (4), Nemaha - 20 (2), Otoe - 20 (1), Cass 10 (1), Sarpy - 13 (2), Douglas - 7 (1), Washington - 20 (0), and Burt - 20 (2). While all of the infested fields

are associated with low-lying, river bottomland soils, four of the fields were located in the central or western sections out of the Missouri floodplain region. Three of these fields were in Richardson and one was in Douglas counties. SORGHUM: A sorghum downy mildew survey was conducted in a 35-county area in south central, east central and southeastern Nebraska in order to determine the incidence and severity of the disease in commercial fields. A minimum of four fields were selected at random in each county. The disease was found to occur in 17 of the 35 counties; it was considered severe and, in a few fields, was felt to be yield-limiting in a four-county area including Nuckolls, Thayer, Fillmore and Clay counties.

Publications: 87/01 to 87/12

POWERS, T. and WYSONG, D.S. 1988. Soybean Cyst Nematode in Nebraska. Crop Prot. Clinic Proc., pgs. 146-148.

JENSEN, S.G., WYSONG, D.S. and DOUPNIK, B., JR. 1988. Sorghum Downy Mildew, The Disease and its Control. Crop Prot. Clinic Proc., pgs. 123-127.

20.022 CRIS0094638

EFFECT OF SOIL FACTORS IN THE SUPPRESSION OF CROP DISEASES CAUSED BY SOIL-BORNE PLANT PATHOGENS

MILLER W W; MAHANNAH C N; THYR B D; Range Wildlife and Forestry; University of Nevada, Reno, **NEVADA** 89557.

Proj. No.: NEV00407 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 85 to 30 JUN 88

Objectives: To identify or develop soil crop management systems that suppress specific soilborne pathogens.

Approach: Through greenhouse investigation the relationship between soil moisture induced plant stress and southern anthracnose, Fusarium, and root-knot nematode development in alfalfa will be characterized. Plants will be allowed to extract soil moisture to various predetermined ranges of soil water potentials, then irrigated back to saturation. Following inoculation, the degree of plant infection for each soil moisture regime will be evaluated. Comparative interpretation as to level of moisture stress, degree of infection, and host pathogen interaction will be subjected to standard statistical analysis.

Progress: 87/01 to 87/12. A one year project extension was proposed and approved to allow completion of a MS Thesis at the end of Spring semester 1988. The effects of water stress on alfalfa yield and interaction with plant disease was investigated. Disease organisms consisted of Fusarium and Meloidogyne (nematode). Plants were subjected to 4 irrigaton regimes and 4 inoculation treatments. Inoculations were none (control), Fusarium, Meloidogyne, and Fusarium/Meloidogyne combined. All treatments were replicated. The first experimental run was completed in August 1987 and the second initiated in November 1987 which should be completed in early 1988. Data from the first experimental run is presently being processed and compiled for interpretive analysis. When combined with the second experimental run a MS Thesis will be prepared.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

20.023 0139915

DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

CHEN T A; MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.

Proj. No.: NJ11285 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes; emphasizing biological and cultural control procedures. Evaluate these tactics and integrate effective procedures into practical nematode management programs which minimize crop losses, environmental contamination, and human health risks.

Approach: Develop efficient and specific detection probes for the diagnosis and identify plant viruses transmitted by nematodev ectors. Biotechnology such as hybridoma techniques and gene probes will be used. Attempt to culture in vitro biological antagonists to nematodes, particularly Pastoria sp. The relationship of the nutritional value of plant roots to nematode production will be investigated. A model system consisting of varieties of Kentucky bluegrass or perennial ryegrass and Tylenchorhynchus maximus will be tested to establish if the nematode's reproduction is affected. Biochemical analyses will then be correlated with reproduction rate.

20.024 CRIS0089895

FORAGE CROP GENETICS AND BREEDING TO IMPROVE YIELD AND QUALITY

VIANDS D R; LOWE C C; Plant Breeding & Biometry; Cornell University, Ithaca, **NEW YORK** 14853.

Proj. No.: NYC-149498 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Develop improved populations in the important cool-season, perennial forage species for forage and seed yield, quality constituents, and resistance to diseases, insects, and environmental stresses. Investigate morphological, anatomical, chemical, and physiological plant characteristics for association with levels of forage quality constituents and predictive potential in feeding value and yield improvement. Evaluate experimental populations and cultivars of forages, for improved feeding value and for improved forage and seed yield.

Approach: Disease-resistant alfalfa germplasm will be developed and evaluated to determine economic benefits of various resistances. Various breeding methods to improve alfalfa populatioons for forage yield and persistence will be compared empirically. Participation in a convergent-divergent selection program will continue to develop birdsfoot trefoil germplasm with crown rot resistance. Alfalfa germplasms developed with improved capability to regenerate roots after taproot severing will be evaluated for forage yield and persistence. Application of near-infrared reflectance spectrometry to breed alfalfa for improved nutritional quality, will be enhanced by evaluating forage sampling techniques, and developing predictive calibration equations for cell wall nitrogen fractions and for protease inhibitor content.

Progress: 87/01 to 87/12. Breeding alfalfa for higher forage quality is being complemented by researching genetic variability and effects of protease inhibitors on reducing protein losses during forage drying. Oneida VR, a cultivar highly resistant to Verticillium wilt (VW), averaged 1.6 tons/acre more hay than did susceptible Saranac AR during the 3rd production year in 4 VW-infested trials. At $85/ton of hay, financial advantage of Oneida VR was $136/acre in the 3rd production year, not accounting for less frequent stand establishment. Although moderately resistant cultivars yielded about 0.8 ton/acre more hay than did susceptible cultivars, resistant and highly resistant cultivars should be recommended where VW is a problem because of their additional 0.5 ton/acre advantage over moderately resistant cultivars. Four new alfalfa cultivars with multiple disease resistance have been developed for use in the Northeast U.S. Selection of alfalfa resistant to root lesion nematodes (Pratylenchus penetrans) in growth chambers was determined to be more successful by replicated clonal evaluation (heritability = 0.45) than by half-sib progeny test (-0.05) or phenotypic selection (0.21). Alfalfa populations developed with 26% more branch roots regenerated after taproot severing survived frost heaving better than did standard cultivars. Crown-rot resistant birdsfoot trefoil plants were sent to Missouri for seed production as part of the convergent-divergent selection program involving 9 cooperators.

Publications: 87/01 to 87/12

VIANDS, D. R. 1988. Variability and selection for characters associated with root regeneration capability in alfalfa. Crop Sci. 28:(in press).

HANSEN, J. L. 1987. Evaluation of progress breeding alfalfa populations with the capability to regenerate roots after taproot severing. M.S. Thesis. Cornell Univ. New York, Ithaca. 103p.

FONSECA, C. E. 1987. Development of a method for breeding alfalfa with resistance to the root lesion nematode. M.S. Thesis. Cornell Univ. New York, Ithaca. 86p.

20.025* CRIS0088272

TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology. Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Ouchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09

RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.

RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

20.026* CRIS0132029
MORPHOLOGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDOGYNIDAE

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

20.027* CRIS0066983
CONTROL OF THE EFFECTS OF PLANT PARASITIC NEMATODES ON WHEAT AND FORAGE CROPS

RUSSELL C C; SINGLETON L L; BURTON R L; Plant Pathology; Oklahoma State University, Stillwater, **OKLAHOMA** 74078.
Proj. No.: OKL01585 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 85 to 30 SEP 90

Objectives: Determine: modes of action, particularly non-nematicidal modes, of commercial nematicides; effects of root diffusates on resuscitation of anhydrobiotic nematodes; influence of nematicide application methods on nontarget pathogen population. Develop nematicide application techniques to the level of economical utilization.

Approach: Above studies will utilize a soil diffusion gradient system that will allow assessment of results over a continum of nematicide concentration in the soil.

Progress: 87/10 to 88/09. The mode of action of the nematicide carbofuran is based on disruption of nematode orientation responses in addition to direct nematicidal activity. Application of this nematicide at the reportedly subnemticidal dosages of .28, .56, and 1.12 kg/ha (rate per 15932.5m of treated row applied infurrow on 25.4 cm centers) was made to all rows (=BRD) or to alternate rows, only (=ALT, which halves the rate of both chemical and carrier compared to BRD). These treatments were compared to the control (water only, 46.81/ha BRD) on the basis of nematode populations and wheat yield. Although yield differences appeared reduced by abundant soil moisture and late planting, increased yields, averaged across 3 locations, were obtained for all nematicide treatments (forage 112 to 126, and grain 103 to 109% of control). ALT treatments accounted for the majority of the significant (P=less than or equal to .10) yield increases (forage 71%, grain 66%). The beneifit ratio for grain yield (kg yield increse over control/kg chemical applied per ha) of the treatments was: .28kg/haALT=634, .28kg/haBRD=271, .56kg/haALT=228, .56kg/haBRD=206, 1.12kg/haALT=156 and 1.12 kg/haBRD=38. Paratylenchus, Merlinius and Pratylenchus spp. population reductions were obtained with the greatest number of significant (P=less than or equal to .10) reductions occurring in the ALT treated rows.

Publications: 87/10 to 88/09

RUSSELL, C.C. 1987. A simple, Inexpensive, High Resolution, In vitro Root Observation Technique. Nematologica 33:(1):119-122.
RUSSELL, C.C. and SINGLETON, L.L. 1988. Nematicide Applications on Winter Wheat, Strategic and Economic Considerations. Proc. Okla. Agric. Chem. Conf. 13:60-63.
SINGLETON, L.L., RUSSELL, C.C. and MERRILL, W.H. 1988. Wheat Root Rot and Nematode Research. Ann. Wheat Newsletter 34:155-156.
WILLIAMS, E., RUSSELL, C.C., STURGEON, R.V. and BARNES, G.L. 1988. Soil and Plant Sampling for Analysis of Nematode Populations. OSU Extension Facts No. 7610, 2 p.

20.028* CRIS0098620
IDENTIFICATION, BIOLOGY AND CONTROL OF NEMATODE PESTS IN OREGON AGRICULTURE

INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: ORE00261 Project Type: STATE
Agency ID: SAES Period: 01 JUN 86 to 31 MAY 91

Objectives: Monitor known nematode problems, as well as identify and evaluate potential new problems which may occur as the result of population increases, disease complexes with microbial pathogens or changes in management practices. Research new and existing chemical and management control measures and evaluate their efficacy and cost efficiency for various known nematode pests. Study the biology of plant disease complexes which include nematodes and microbial pathogens.

Approach: A current knowledge of nematode species affecting Oregon agriculture will be maintained by examining samples submitted to the Plant Clinic and by occasional surveys. Chemical control will be examined by treating research plots in growers' fields with new and existing nematicides. Chemicals will be screened for efficacy, phytotoxicity and plant residue. Management practices to be examined

include crop rotation sequences and the effects of cover crops on nematode populations in perennial crops. Microplots containing either potatoes or mint will be inoculated with nematodes, Verticillium, both or neither pathogen. Plant growth and yield will be examined for evidence of interactions between the two pathogens.

Progress: 87/01 to 87/12. Vydate 2E at 1 lb ai/A, Mocap 6E at 3 or 6 lb/A and Mocap 10 G at 6 lb/A were evaluated for control of lesion and pin nematodes on peppermint. Treatments were applied on April 15 or 29 to compare efficacy of different treatment dates but nematode densities in almost all treatments were not significantly different between application dates. Soil populations of lesion nematodes on May 28 were significantly less in the Mocap 6E on April 29 treatment than in the control and all other treatments except Mocap 10G on April 29. At harvest (August 3), densities were lowest in the Mocap 6E on april 29 treatment but were only significantly less than densities in the Vydate treatments. On May 28, numbers of pin nematodes were significantly less in the Vydate and Mocap 10G treatments than in the control. However, on August 3 only the April 15 treatment of Vydate had significantly fewer nematodes that in the control. Nemacur 3 at 6 or 12 lb ai/A was evaluated for control of lesion nematodes on highbush blueberry. The 12 lb ai/A rate significantly reduced lesion nematode populations as compared to the nontreated control but densities were not significantly different from those treated with 6 lb ai/A. Post treatment densities in the 6 and 12 lb ai/A treatments averaged 55% and 5% of those in the nontreated control, respectively.

Publications: 87/01 to 87/12

KAROW, R.S. and INGHAM, R.E. 1986. Cereal cyst nematode (Heterodera avenae Woll.). OSU Crop Science Report, EXT/CRS 66, 5 p.

INGHAM, R.E. 1987. Root-knot nematodes--preventing a potential problem. Proceedings of the 1987 Oregon Potato Conference and Trade Show, pp. 51-55.

20.029* CRIS0094346

BIOLOGICAL CONTROL OF SOIL-BORNE PLANT PATHOGENS IN INTEGRATED CROP MANAGEMENT SYSTEMS

BUCHENAU G W; SMOLIK J D; RIZVI S A; Plant Science; S Dakota State University, Brookings, **SOUTH DAKOTA** 57007.

Proj. No.: SD00234 Project Type: HATCH
Agency ID: CSRS Period: 09 OCT 84 to 30 SEP 89

Objectives: To develop biotic agents for plant disease control. To assess the effect of tillage and crop residue management practices on soil micro-organisms and plant health. To integrate biological control into crop disease management systems.

Approach: We will attempt to develop biocontrol agents effective against certain soil-borne pathogens of wheat and alfalfa including Cochliobolus sativus, Fusarium graminearum, Pythium ultimum, Pyrenophora tritici-repentis and selected nematode species by searching for soils suppressive to these pathogens and isolating biocontrol agents from such soils, or by stimulating populations of biocontrol agents by periodic reinfestation of soil with the target organisms. Mutants of antagonistic Gliocladium and Trichoderma spp that are more effective at low temperature and high pH, and which have tolerance to appropriate fungicides will be developed for use in integrated disease control systems. Effect of minimum tillage and organic farming systems on Fusarium, Pythium and nematode populations will be studied at selected sites, and the fate of C. sativus spores will be studied under various tillage systems at Doland.

Progress: 87/01 to 87/12. In a field experiment, seed treatment of wheat with Gliocladium virens reduced the number of heads per row in natural soil, but increased the number of heads per row in soil artificially infested with Pythium ultimum (PU) or Cochliobolus sativus (CS). Both pathogens reduced the number of heads of untreated wheat. Pythium oligandrum seed treatment increased head numbers in CS infested soil, but a similar increase in PU soil was not significant at the 5% level. G. virens was not as good as Vitavax 200 in natural soil, and P. oligandrum was not as good as Vitavax 200 in PU soil, otherwise, the biocontrols did not differ statistically from the standard. None of the treatments affected weight per kernel. Soils suppressive to Pythium and to CS have been detected in certain soils from a series of rotation-tillage studies, but suppressiveness has not been consistently associated with treatment nor with measured microbial variables. Chloride fertilization of wheat resulted in significant yield increases at one location but not at a second location in 1987. There was not a significant effect of chloride on common root rot as indicated by subcrown internode necrosis, but leaf disease was reduced by chloride at the responsive site. Leaf rust, Septoria blotch and tan spot all were reduced to some degree. Yield response of cultivars to chloride was not always explained by foliage disease reduction. However, there was virtually no leaf disease present at the site with no yield response to chloride.

Publications: 87/01 to 87/12

BUCHENAU, G., RIZVI, S. and AHMED, I. 1987. Effect of foliage fungicides on diseases of spring wheat in South Dakota. APS Fungicide-Nematicide Tests 42:114-115.

CHOLICK, F.A., GELLNER, J.L., BUCHENAU, G.W., SCHUT, R. and RIZVI, S. 1987. South Dakota Wheat. Ann. Wheat News. 33:162.

SMOLIK, J.E., ET AL. 1986. Farming Systems Studies. Northeast Exp. Sta. Ann. Prog. Rep. Plant Sci. Pamph. 100:25-42.

20.030* CRIS0143120
BIOLOGY AND CONTROL OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH FIELD, FORAGE, AND RANGELAND PLANTS

GRIFFIN G D; Agricultural Research Service, Logan, **UTAH** 84322.
Proj. No.: 5428-24000-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 04 AUG 88 to 03 AUG 93

Objectives: Determine the biological relationship between plant parasitic nematodes andfield, forage, and rangeland vegetation. Determine the ecological and environmental impact of soil-borne organisms on the host-parasite relation-ship between nematodes and plants. Determine the importance of cultural practices, soil types, and control methodologies on nematode population dynamics and host-parasite associations. Develop pest management procedures that will reduce crop/environmental losses caused by nematodes.

Approach: Determine species and population dynamics of plant parasitic nematodes associated with the growth and development of forage, rangeland vegetation,grains, and other field crops under natural and artificial conditions with macro and microstudies. Measure crop losses in relation to nematode-environmental relationships and qualitative-quantitative analyses. Evaluatenematode control methodologies to determine most efficaciouss method(s) with minimal effect on envionmental impact and ecosystem balance. Measure importance of interactions between nematode and pathogenic and beneficial microbes on the growth of plant cultivars using proven and newly developed techniques and methodologies.

20.031* CRIS0049759
BIOLOGY AND CONTROL OF PLANT-PARASITIC NEMATODES ASSOCIATED WITH FIELD, FORAGE AND RANGELAND PLANTS

GRIFFIN G D; Agricultural Research Service; Agricultural Research Service, Logan, **UTAH** 84322.
Proj. No.: 5428-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 84 to 30 SEP 88

Objectives: Determine namatode species associated with field, forage & rangeland vegetation. Determine host-nematode relationship on field, forage & rangeland plants. Determine importance of environment, associated soil borne organisms, soil types, cultural practices, & control of methodologies (resistance, tolerance, biological, physical & chemical) on nematode population dynamics & host/parasite relationships. Develop IPM technologiesthat will reduce and control nematode numbers & nematode related diseases.

Approach: Measure crop losses in relation to namatode population thresholds, nematode-environmental relationships, and qualitative-quantitative analyses. Evaluate nematode control methodologies to determine most efficacious method(s) with minimal effect on environmental impact and ecosystem balance; study nematode biology and host/parasite relationships with macro and microstudies involving manipulation of nematode populations,intrinsic and extrinsic factors, and varying cultural practices. Measure importance of interactions between nematode, and pathogenic and beneficial microbes on forage, field, and range plants under different environmental conditions.

Progress: 87/01 to 87/12. Nematode resistant alfalfa, Nevada Synthetic XX, differed in its response and degree of resistance to Meloidogyne hapla populations from California, Utah, Washington, and Wyoming, and was 100% susceptible to one California population; Ranger alfalfa was 100% susceptible to all populations. Species of Astragalus, Coronilla, Hedysarum, Lathyrus, Lotus, Medicago, Melilotus, Onobrychis, Trifolium, and Vicia differed in susceptibility and nitrogen fixation to Meloidogyne hapla and M. chitwoodi populations. Population densities of Merlinius brevidens, Quinisulcius acutoides, and Pratylenchus neglectus are greater under continuous no-till and chemical fallow no-till regimentations than other conventional fallow cultivation of wheat. The susceptibility of resistant Apollo II and Nevada Synthetic XX, and susceptible Ranger alfalfas to combined inoculations of M. hapla and Phytophthora megasperma f. sp. medicaginis was greatest at 28 C. There was a direct relationship between M. hapla and M. chitwoodi population densities and the growth of Lahontan alfalfa, Hycrest wheatgrass, and Russian wildrye in a competitive plant study; increased nematode population densities reduced plant growth of both resistant and susceptible plants.

Publications: 87/01 to 87/12

GRIFFIN, G.D. 1987. The importance of environmental factors and cultural practices on parasitism of alfalfa by Ditylenchus dipsaci. J. Nematol. 19: 267-276.

GRIFFIN, G.D. 1987. The interaction of Ditylenchus dipsaci and Meloidogyne hapla on susceptible and resistant plants. J. Nematol. 19:441-446.

GRIFFIN, G.D. 1987. Efficacy of using split and post-plant applications of aldicarb to control Heterodera schachtii on sugarbeet. Ann. Applied Nematol. 1:119-122.

GRIFFIN, G.D. 1987. Nonvolatile nematicide control of Heterodera schachtii on sugarbeet. J. Am. Soc. Sugarbeet Tech. Accepted July 20, 1987.

EISENBACK, J.D., and GRIFFIN, G.D. 1987. Interactions with other nematodes. pp. 313-320. In: VEECH, J.A. and DICKSON, D.W. (eds.) Vistas on Nematology. Hyattsville, MD, Society of Nematologists, Inc.

GRIFFIN, G.D., and THYR, B.C. Interaction of Meloidogyne hapla and Fusarium oxysporum f. sp. medicaginis on alfalfa. Phytopathology. Accepted Oct. 6, 1987.

GRIFFIN, G.D. Factors affecting t he biology and pathogenicity of Heterodera schachtii on sugarbeet. J. Nematol. Accepted May 26,

1987.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

20.032 CRIS0048412
SELECTION CRITERIA FOR ALFALFA IMPROVEMENT IN THE PACIFIC NORTHWEST

PEAOEN R N; Soil & Water Management Research Unit; Agricultural Research Service, Prosser, **WASHINGTON** 99350.
Proj. No.: 5354-22000-003-000
Project Type: INHOUSE
Agency IO: ARS Period: 14 JUL 83 to 14 JUL 88

Objectives: Oetermine selection criteria for pest resistance and yield in alfalfa. Specific areas will include inheritance of resistance to Verticillium wilt, resistance to root and stem nematodes, selection to avoid yield decline and cooperation with other locations..

Approach: Selfs and diallel and test crosses, with emasculation of selected alfalfa clones, will be used to determine inheritance of resistance to Verticillium wilt. Controlled environment studies, in cooperation with nematologists, will be used to determine techniques and criteria for assessing damage by Root lesion nematodes and application of the information to selection procedures. Measurement of light interception and morphological characteristics of alfalfa in different canopy conditions will be conducted in cooperation with a physiologist. Data on stem nematode and bacterial wilt resistance and forage yields will be obtained for use in possible validation of a computerized autotetraploid model being developed at another location.

Progress: 87/01 to 87/12. Verticillium wilt test of over 700 plant introduction accessions of alfalfa show 28 with resistance greater than 20% and an additional 122 with resistance between 10 and 20%. Only accessions which trace to improved cultivars contained resistance equal to or better than Vertus'. Eight accessions from Russia which were not sativa were among the 28 with resistance greater than 20%. Seed of three experimental alfalfa lines with possible tolerance or resistance to lygus feeding damage were increased for possible germplasm release. These lines were developed from seed from the Arizona entomology project. One is a non-dormant and two are semi-dormant types. An experiment designed to investigate possible Verticillium wilt x AMV interaction revealed that AMV inoculation techniques need to be improved. A seed production trial indicated that leaf cutter bees are less active in pollination of yellow-flowered plants when purple-flowered types are available nearby. Plant selections based on flowering habit and on stem diameter were made in four alfalfa germplasm sources to provide material for investigations of yield characteristics in alfalfa. Seed increase of plant introduction accessions were begun at Prosser with 120 entries established and successful production on over 100.

20.033* CRIS0065796
DEVELOPMENT OF THE BASIC PARAMETERS FOR NEMATODE PEST MANAGEMENT DECISIONS

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP00240 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extracting methodology for nematode detection and assessment; determination of the relationship between crop losses and nematodes as affected by environmental conditions; and determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: An in-depth sampling study in a center pivot irrigated potato field will be conducted to detect and assess Meloidogyne chitwoodi populations (eggs and juveniles). Factors to be investigated will include: number of subsamples/unit area; soil depth between 0-6'' time of sampling (weekly to monthly); soil type, and cropping sequence. Extraction procedures currently used in WA will be critically examined and compared to other methods to determine the most efficient extraction method and to quantify the level of efficiency. Population densities of M. chitwoodi and M. hapla will be manipulated by inoculation of cropping sequence in microplot and field trials to determine damage functins on several crops. Yield and/or quality of potato, carrots, beans and peas will be related to initial population densities of the nematodes. The influence of environmental conditions and control strategies (crop rotation, resistant varieties and pesticides) on damage functions will be determined.

Progress: 87/01 to 87/12. Reproductive factor (Pf/Pi) of Meloidogyne chitwoodi (MC) race 2 on 44 crop cultivars ranged from 0-130. Nonhost crops (R=0) included asparagus, cowpea, lima bean, peanut, spearmint, strawberry and a hydrid turnip. Reproductive efficiency of MC race 1 and 2 was also compared on selected crop cvs. Both races failed to increase on 9 onion cvs. (R=0=-0.2) and R values on 9 corn cvs. ranged from 0.8-16.9. Alfalfa cvs. Nevada Syn XX and W12SR2W1 exhibited high degree of resistance to M. hapla (MH) and MC races 1 and 2. Population of individual plants of Nevada Syn XX were 100, 90, and 91% resistant to MH, MC1 and MC2, respectively, and W12SR2W1 55, 100 and 65% resistant. In field microplot studies the damage threshold level of MH on Chantenay Red Cored and Orlando Gold carrot was estimated to be 16.7 and 5.6/250 CM soil, respectively. Damage level for MC races was >2000/250 cm soil. Vertical migration studies in columns buried in the field showed that MC was able to migrate upwards from depths of 60, 120 and 180 cm to infect tomato roots. MC eggs and juveniles placed at 60 cm infected tomato roots within 30 days, while those placed at 120 and 180 cm were detected in tomato roots after 60

days. A total of 1.5 and 3-acre-inches water applied in 8 days was able to move ethoprop down only 10 to 20 cm, respectively, in conceptrations to control MC. Ethoprop at 0.62 mu g/g was able to prevent invastion by MC. Ethoprop EC at 6.7 AI ka/ha protected the treated zone from migrating nematodes for 5 weeks.

Publications: 87/01 to 87/12

PINKERTON, J.N., MOJTEHEDI, H., and SANTO, G.S. 1987. Reproductive efficiency of Pacific Northwest isolates of Meloidogne chitwoodi on alfalfa. Plant Disease 71:345-348.

PINKERTON, J.N., MOJTAHEDI, H., SANTO, G.S. and O'BANNON, J.N. 1987. Vertical migration of Meloidogyne chitwoodi and M. hapla under controlled temperature. J. Nematol. 19:152-157.

MOJTAHEDI, H., SANTO, G.S. and WILSON, J.H. 1987. Host range of Meloidogyne chitwoodi race 2 (alfalfa race). J. Namatol. 19(4) (Abstr.)

MOJTAHEDI, H., PINKERTON, J.N., SANTO, G.S. and PEAOEN, R.N. 1987. Reproductive efficiency on Meloidogne chitwoodi race 2 and its pathogenicity on alfalfa cultivars. J. Nematol. 10(4) (Abstr.).

20.034 CRIS0084952

QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESS

GRAY F A; Plant Soil & Insect Science; University of Wyoming, Laramie, **WYOMING** 82070.

Proj. No.: WYO-170-81 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Oetermination of the relationship between crop loss and nematodes as affected by environmental conditions.

Approach: The influence of cold temperature on the survival of alfalfa infected with stem nematode, Oitylenchus dipsaci will be studied. The relationship between soil inoculum density, internal nematode populations and visual disease severity to below freezing temperatures will be determined. Studies will be conducted in the greenhouse and in controlled environmental chambers. Plant survival, height and forage yield data will be collected.

Progress: 87/01 to 87/12. Comparative pathogenicity of two populations of the northern root-knot nematode, Meloidogyne hapla, were studied on alfalfa and sainfoin. One population was from alfalfa and one from sainfoin, Onobrychis viciifolia. Both were collected from Wyoming. Nematode eggs (1,500/seed) were applied at planting. Significantly (P=.05) greater plant mortality in both crops occurred with the sainfoin population as compared to either the uninoculated control or the alfalfa population. After 25 weeks, plant count means (4 replications, 20 seeds/pot) for the uninoculated control, alfalfa population and sainfoin population were 18.1, 15.7, 12.8 and 16.9, 10.2, 8.2 for alfalfa and sainfoin, respectively. Alfalfa and sainfoin plants inoculated with the sainfoin population yielded significantly less than plants inoculated with the alfalfa population. Results indicate differences occur in breeding programs involving this root pathogen.

Publications: 87/01 to 87/12

GRAY, F.A., SOH, O.H. and GRIFFIN, G.O. 1986. The chrysanthemum foliar nematode, Aphelenchoides ritzemabosi, a parasite of alfalfa (Abstract) North American Alfalfa Improvement Conference, July 1986, St. Paul, MN.

GRAY, F.A. and SOH, O.H. 1986. Efficacy of a nematicide seed treatment in controlling seedling blight of alfalfa incited by Oitylenchus dipsaci and Meloidogyne hapla. Phytopathology 76:1139 (Abstract).

GRAY, F.A., WOFFORO, O.S. and ECKERT, J.W. 1987. Comparative pathogenicity of two populations of Meloigoyne hapla from alfalfa and sainfoin. Abstract. 1987. Western Society of Crop Science, pp. 22.

20.035 CRIS0097188

THE INTERACTION OF NORTHERN ROOT-KNOT NEMATODE AND PHYTOPHTHORA ROOT ROT IN ALFALFA

GRAY F A; GRIFFIN G O; JOHNSON O A; Plant Soil & Insect Science; University of Wyoming, Laramie, **WYOMING** 82070.

Proj. No.: WYO-2-2705
Project Type: SPECIAL GRANT
Agency IO: CSRS Period: 01 JUL 85 to 30 JUN 89

Objectives: Oetermine the sequence of pathogen inoculation, cultivar, soil type and soil temperature on disease. Oetermine the effect of disease (all pathogen combinations) on mortality, yield and nitrogen fixation.

Approach: The interaction between two soil-borne pathogens (Phytophthora megasperma and Meloidogyne hapla) of alfalfa will be studied under controlled environmental conditions. Pathogen and/or pathogens (singular or in combination) will be studied on both susceptible and resistance (susceptible or resistant to one or both pathogens) cultivars. The effect of soil type and soil temperature will also be studied. Tests will be run for 4-6 months to allow for sufficient disease development. Oata on plant mortality, yield, root disease ratings, fungal and nematode isolations and nitrogen fixation will be collected.

Progress: 87/01 to 87/12. The interaction between Phytophthora megasperma f. sp. medicaginis and Meloidogyne hapla was studied during the seedling growth phase in three alfalfa cultivars varying in resistance to the two root pathogens. Post-emergence damping-off, attributed to P. megasperma f. sp. medicaginis (Pmm), was significantly (P=.05) decreased in two of three cultivars when 4-day-old seedlings were inoculated with both M. hapla (Mh) and Pmm, at planting. Percent loss (percent of control) at 2 wk for Apollo II (resistant to Pmm, susceptible to Mh), Nevada Synthetic XX (resistant to Pmm, highly resistant to Mh) and Oeseret (susceptible to Pmm and Mh) was 56 and

26, 55 and 21, and 71 and 35, in the Pmm alone and Pmm plus Mh treatments, respectively. After 7 wk, in the Pmm alone treatment, both Apollo II and Nevada Synthetic XX, classified as resistant, had significantly less seedling loss than Deseret, classified as susceptible. Percent seedling loss at 7 wk for the three cultivars was 32, 45 and 77. Statistical separation of cultivars was not possible in the combination treatment due to the reduced damping-off. After 7wk, when the experiment was terminated, Phytophthora root rot was significantly increased in the remaining plants of the susceptible cultivar Deseret in the combination treatment as compared to Pmm alone. The presence of Pmm with Mh resulted in an overall reduction in both root galling and egg reproduction in all three cultivars.

Publications: 87/01 to 87/12

GRIFFIN, G.D., GRAY, F.A. and JOHNSON, D.A. 1985. Interaction of Meloidogyne hapla and Phytophthora megasperma on Rhizobium nodulation, nitrogen fixation, yield and mortality of alfalfa (ABSTRACT). 1985. West. Alfalfa Improve. Conf. Proc.

GRIFFIN, G.D., GRAY, F.A. and JOHNSON, D.A. 1986. The effect of Meloidogyne hapla on Phytophthora root rot of alfalfa. European Society of Nematologist XVIIIth Intl. Symposium, Sept. 7-12, 1986, Antibes, France.

20.036 CRIS0081800
DISEASES OF FORAGE LEGUMES

GRAY F A; WOFFORD D S; WOFFORD D S; Plant Soil & Insect Science; University of Wyoming, Laramie, **WYOMING** 82070.
Proj. No.: WYO-162-81 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: Identify and determine importance of diseases in forage legumes in Wyoming. Emphasis will be placed on alfalfa and sainfoin. Develop and improve methodology useful in disease control. Study the interactive effect of disease and low temperature stress on plant growth and survival.

Approach: Identify new pathogens of forage legumes previously not identified in Wyoming and/or the United States. Importance of each will be determined through loss assessment studies. Study disease etiology relative to control strategies. Evaluate the effectiveness of fungicides and nematicide seed treatments in combination with host resistance for maximum disease control. Evaluate sainfoin cultivars for their reaction to disease. Evaluate existing and develop new screening methodology useful in the development of disease resistant sainfoin lines. Conduct low temperature-disease interaction studies to identify and determine importance of disease associated with winterkill in alfalfa.

Progress: 87/01 to 87/12. Laboratory studies were conducted to determine genetic variability among 35 isolates of Phoma medicaginis var. medicaginis from alfalfa for spore production and pathogenicity. Spore production on potato dextrose agar ranged from 350,000 to 601,500,000 conidia/ml (each plate was washed with 10 ml water, 5 plates/isolate) after 4 weeks at 27C. Mean spore concentration of the 35 isolates was 123,870,000 conidia/ml. Spore production in 48.6% of the isolates was >10 and <20 conidia/ml. Only one isolate produced less than 10 conidia/ml. Pathogenicity of isolates was determined using an in vitro, detached-leaf technique. Trifoliate leaves from a spring black stem-susceptible alfalfa clone were surface infested and placed in glass incubation chambers. Leaves received a total of three sprays over 48 hrs. The experiment was conducted in a controlled environmental chamber set at 21C. After 7 days, leaves and petioles were rated for spring black stem and averaged. Frequency distribution among isolates was; 0, 2, 4, 9, 12, 6, 1, 0, 0, 0 and 0 isolates produced disease in the 0-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90-100 percentile groups, respectively. Disease in the majority of isolates (74.3%) was rated as moderate (20-44% disease). Correlation coefficient between spore concentration and disease was nonsignificant.

Publications: 87/01 to 87/12

GRAY, F.A., WOFFORD, D.S. and GRIFFIN, G.D. 1986. First report of the northern rootknot nematode on sainfoin in the United States. Plant Disease 70:694.

WOFFORD, D.S. and GRAY, F.A. 1987. Evaluation of cultivars, experimental lines and plant introduction collections of sainfoin for resistance to the northern rootknot nematode. Journal of Nematology 19(1):30-37.

GRAY, F.A. and WOFFORD, D.S. 1987. Phytophthora seed rot and seedling blight of sainfoin, Onobrychis viciifolia. Plant Disease 71:74-78.

20.037 0138987
INTERACTION OF APHELENCHOIDES RITZEMA-BOSI AND DITYLENCHUS DIPSACI IN ALFALFA

GRAY F A; GRIFFIN G D; Plant Soil & Insect Science; University of Wyoming, Laramie, **WYOMING** 82071.
Proj. No.: WYO-8902598
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 AUG 89 to 31 JUL 90

Objectives: Determine distribution of the chrysanthemum foliar nematode (Aphelenchoides ritzema-bosi) and its association with the stem nematode (Ditylenchus dipsaci) in alfalfa in the western region. Determine the pathogenicity of A. ritzema-bosi alone and in combination with D. dipsaci in alfalfa.

Approach: Researchers in the western region will be solicited for alfalfa samples showing typical symptoms of the stem nematode. Nematodes will be extracted from sample tissues and the number of each nematode genera determined. Both nematodes will be cultured in vivo or in vitro on either callus tissue, fungus cultures or hold plants. Once nematode cultures have been established, pathogenicity

studies will be conducted in environmentally controlled greenhouse and growth chamber facilities. Plants will be inoculated with A. ritzema-bosi alone, D. dipsaci alone and a combination of both and symptom development closely followed to determine the role of A. ritzema-bosi in the stem nematode disease of alfalfa.

Progress: 89/01 to 89/12. Alfalfa plants infected with Aphelenchoides ritzema-bosi and Ditylenchus dipsaci were collected from fields and established in pots in the greenhouse during late summer 1989. Current work is being devoted to the establishment of auxenic cultures of both parasitic nematodes on alfalfa callus tissue and on whole plants. Once sufficient inoculum is avaiable the interactive effect of A. ritzema-bosi and D. dipasci will be studied on seedling and mature plants of alfalfa. Alfalfa plants, with typical stem nematode (D. dipsaci) symptoms will be solicited in the early spring of 1990 to determine the distribution of the chrysanthemum nematode (A. ritzema-bosi) in the western region.

Publications: 89/01 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

21.001* CRIS0140544
CHEMISTRY OF HOST PLANT RESISTANCE TO INSECTS, DISEASES, AND NEMATODES

JENKINS J N; HEDIN P A; Cotton Host Plant Resist Res Crop Science Res Lab; Agricultural Research Service, Mississippi State, **MISSISSIPPI** 39762.
Proj. No.: 6406-24000-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: To develop more efficient methods for selecting and enhancing cotton, corn,and forage crop germplasm with improved resistance to pests; and to assist in the rearing of quality insects.

Approach: Develop new information on the chemical bases of plant-pest interactions with special emphasis on host plant resistance to major insect, nematode, and disease pests, including boll weevil and Heliothis spp. and assist in the development of information on the chemical and nutritional requirementsto rear high quality insects. Special attention will be given to resist- ance mechanisms which may be common among host crops or important in multiple pest resistance. Allelochemics will be isolated and identified through chemical structure/bioassay. Develop analytical procedures to provide guidance to plant scientists developing resistant germplasm. Elucidate biochemical mechanisms of allelochemicals biosynthesis and action.

Progress: 87/01 to 87/12. Twelve PGR's were applied to ST 213. High rates of gibberelic acid reduced boll size. Gibberellic acid increased yield. Several PGR's reduced yield. Kinetin increased the plants natural resistance to TBW. Previous work showed PIX and chlormequat gave higher protein content in leaves and squares and led to selection of 10 structurally related compounds for testing. Protein analyses are not complete. None affected yield, lint percent or boll size. Seed size was increased by several. Squares and leaves of diverse cotton breeding lines were analyzed for total gossypol and by HPLC for individual terpenoid aldehydes and heliocides. Generally, the HPLC profiles were predictors of TBW resistance. In studies of boll weevil oviposition deterrence, surface glands of resistant lines generally contained more caryophyllene, humulene, and B-bisabolol. Anthers of resistant lines had less gossypol, but more of several long chain waxes. Work to develop a more reliable bioassay is in progress. In continuing work on the whorl juices from corn resistant to FAW, the total solids were found to contain mostly sugars and amino acids. Both the Susceptible and Resistant produced stimulatory amino acid fractions, but the fractions from susceptible lines were more stimulatory. Sugar fractions were minimally stimulatory. Individual amino acids responded differently. Nutritional implications are evident. Results with callus tissue were similar to those with juice.

Publications: 87/01 to 87/12

BIRD, T.G., HEDIN, P.A., and BURKS, M.L. 1987. Feeding deterrent compounds to the boll weevil, Anthonomus grandis Boheman in Rose-of-Sharon, Hibiscus syriacus syriacus L. J. Chem. Ecol. 13:1087-1097.
THOMPSON, A.C., NICOLLIER, G.F., and POPE, D.F. 1987. Indolealkylamines of Desmanthus illinoensis and their growth inhibition activity. J. Agric. and Food Chem. 35:361-365.
PARROTT, W.L., HEDIN, P.A., JENKINS, J.N., and MCCARTY, J.C., Jr. 1987. Feeding and recovery of gossypol and tannin from tobacco budworm larvae. Southwestern Entomol. 12:197-204.
PARROTT, W.L., JENKINS, J.N., and MULROONEY, J.E. 1987. Relationship between gossypol gland density on cotton squares and resistance to tobacco budworm larave. Proc. 1987 Beltwide Cotton Conference. p. 92. (Abstract)
LYDON, J., DUKE, S.O., and HEDIN, P.A. 1987. Coextraction of 5-(hydroxymethyl)2-furaldehyde with phenolic acids in acid-hydrolyzed plant extracts. J. Chromatography 410:474-479.
MILES, D.H., LY, A.M., RANDLE, S.A., HEDIN, P.A., and BURKS, M.L. 1987. Alkaloidal insect antifeedants from Virola calophylla Warb. J. Agric. and Food Chemistry 35:794-797.

21.002 CRIS0091873
PERIDERM ONTOGENY IN NORMAL AND NEMATODE-INFECTED ROOTS OF COTTON

DUTE R R; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: ALA00616 Project Type: HATCH
Agency ID: CSRS Period: 21 OCT 83 to 30 SEP 88

Objectives: Initiate a detailed light and ultrastructural study of periderm initiation and growth in uninfected cotton roots. evaluate wound periderm formation in nematode-infected roots and its relationship to Fusarium(underlined) susceptibility.

Approach: Healthy tap roots from cotton seedlings grown under controlled conditionswill be processed both for light microscopy and transmission election microscopy. Study will be concentrated on the initiation and development of the periderm, a tissue which affects both water uptake and disease resistance. Nematode-infected cotton roots typically show tissue splitting at the sites of nematode infection and development. These splits may provide a pathway of infection for secondary pathogens such as the Fusarium(underlined) wil organisms. In order to determine whether such wounds are isolated from the rest of the root by a wounded-induced periderm, cotton roots of varieties with different Fusarium(underlined) resistance will be grown under controlled conditions; infected with the nematode Meloidogyne(underlined) incognita(underlined);and processed as above.

Progress: 87/01 to 87/12. Recent work has centered on the changes in cotton roots as they age. In young roots the endodermis contains tanniferous compounds having antipathogenic properties. Electron micrographs show the material in question to be deposited as electron-dense bodies within vacuole adjacent to the vacuolar membrane. During early stages of deposition, tannins may be associated with numerous membrane profiles. When surrounded by the tannins, the membranes stand-out in negative relief. Appearance and development of tannins are similar to deposits in the developing seedcoat of soybean. With continued root development, outer cell layers of the cotton root are replaced by the periderm. During this process, inner periderm cells and root stele cell within the periderm develop contents of similar appearance to those of the endodermis. It is hypothesized that not only does the periderm form a physical barrier to pathogen entry by its suberized surface but also provides the proper environment for the development of chemical defenses. In work of a related nature dealing with root ontogeny, studies were initiated on the weed Diodia virginiana under the leadership of Dr. R. Dickens. As in cotton roots, buttonweed roots form a periderm which replaces the epidermis as the dermal tissue. The meristem of the periderm assists in formation of a starch storage parechyma, which in turn forms adventitious buds, an effective means of vegetative reproduction.

Publications: 87/01 to 87/12

DUTE, R.R., BAIRD, J.H., RUSHING, A.E. and DICKENS, R. 1987. The anatomy of vegetative reproduction of Virginia buttonweed. Agronomy Abstracts, p. 134.

RUSHING, A.E., DUTE, R.R., BAIRD, J.H., GUDAUSKAS, R.T. and DICKENS, R. 1987. Ultrastructural aspects of a virus-like disease in Virginia buttonweed. Agronomy Abstracts, p. 138.

21.003 CRIS0069819

HOST PLANT RESISTANCE IN COTTON TO INSECTS, MITES, NEMATODES AND DISEASES

MCCLURE M A; Plant Pathology; University of Arizona, Tucson, **ARIZONA** 85721.
Proj. No.: ARZT-137014-R-05-005
Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 75 to 30 SEP 85

Objectives: Determine the nature of resistance.

Approach: Anatomical and histochemical characteristics will be investigated, separately and in combination, establish their resistance to boll rot, spider mites, nematodes, wilts, soreshin and other diseases or tests. TX-AR. Scanning and transmission electron microscopy will be used to determine the initial responses of cotton roots to infection by root-knot nematodes. Information exchange between investigated by autoradiographic and electron microscopic cell labelling techniques.

Progress: 87/01 to 87/12. Stylet exudate was induced from infective juveniles of Meloidogyne incognita by treatment with 0.5% catechol, resorcinol, hydroquinone, and caffeic acid. Exudate was visualized by addition of 0.0500% Coomassie Blue to the incubation medium. Stylet exudation was accompanied, in induced nematodes, by stimulation of the subventral glands, accumulation of secretory granules in the ampullae of the gland extensions and stylet thrusting activity. Exudate from 0.5-1.0% grams of juveniles was solubilized in 1.0% SDS, concentrated by ultrafiltration, and separated on SDS-PAGE gradient gels. More than 12 protein bands were detected by silver staining gels. Differences in banding patterns were demonstrated between extracts of resorcinol-treated nematodes and those of controls. Western blots of these gels, when treated with monoclonal antibody to amphidial exudate of M. incognita demonstrated that two of the major protein bands were of amphidial origin. The remaining bands are under investigation to determine their origins within the nematode.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

21.004 0137973

ECOLOGY AND MANAGEMENT OF PLANT PARASITIC NEMATODES ON COTTON

KIRKPATRICK T L; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK01367 Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 89 to 30 APR 94

Objectives: To evaluate plant-parasitic nematodes in cotton in Arkansas. To study the ecology and population dynamics of economically important species with the emphasis on the development of management strategies for minimizing yield loss in cotton. To investigate the effects of nematode parasitism on host physiology and growth with particular emphasis on host plant-water relations. To evaluate sources of genetic resistance to Meloidogyne incognita and other nematode species appropriate.

Approach: Surveys will be intensified to determine the extent and possible significance of nematodes. Field and greenhouse experiments will be initiated in cooperation with workers at LSU to study the ecological significance of various cotton management practices such as genetic resistance to diseases, crop rotation, and use of cover crops in the management of the fusarium wilt/root-knot nematode complex. Studies already in progress to quantify changes in cotton plant-water relations induced by nematode infection will be expanded. Growth chamber, microplot and field studies will be utilized for these investigations. Studies will include quantification of nematode induced changes in water movement through plants, effects of infection on host osmotic adjustment, and the significance of these changes on host growth and yield. Field studies will be conducted each year to evaluate new cotton germplasm for resistance to Maloidogyne

incognitaand Fusarium oxysporum.

Progress: 89/01 to 89/12. Studies to quantify the effects of infection of cotton by Meloidogyne incognita on plant-water relations were conducted. Nematode infection had no effect on plant height, weight, leaf area, or root length of either M. incognita resistant or susceptible cultivars. Infection did, however, significantly decrease pressure-induced water flow through roots of the susceptible but not of the resistant cultivar. The degree of flux decrease was roughly equivalent to that seen in uninfected plants which were subjected to a severe water stress. Nematode effects on water flux were not reflected in post-stress measurements of transpiration, stomatal resistance, or leaf water potential, and infection did not influence the osmotic adjustment ability of M. incognita susceptible cotton. Studies of the effects of high levels of M. incognita resistance were conducted in a field with high levels of both Fusarium oxysporum f. sp. vasinfectum and M. incognita. Resistant lines exhibited few symptoms (>10% wilt) while a high percentage (50-70%) of wilted plants were seen by mid-season for a nematode susceptible cultivar. Populations of M. incognita declined substantially under resistant lines but populations of F. oxysporum did not decline appreciably. Numerous cotton cultivars and breeding lines were evaluated for performance in both field and microplots in soil infested with M. incognita.

Publications: 89/01 to 89/12

KIRKPATRICK, T.L. and SHEPHERD, R.L. 1989. Response of four root-knot nematode/fusarium wilt resistant cotton breeding lines when grown in a field infested with both Meloidogyne incognita and Fusarium oxysporum f. sp. vasinfectum.

KIRKPATRICK, T.L. OOSTERHUIS, D.M. and WULLSCHLEGER, S.D. 1989. Effect of nematode infection on various morphological and physiological characteristics of two cotton cultivars. Proc. of the Beltwide Cotton Prod. Res. Conf., Nashville, TN.

KIRKPATRICK, T.L. and OOSTERHUIS, D.M. 1989. Root-knot nematodes and water stress in seedling cotton. Proceedings of the1989 Cotton Research Meeting. Univ. of Ark. Agric. Exp. Stn.Special Report 138 57-62.

KIRKPATRICK, T.L., OOSTERHUIS, D.M. and WULLSCHLEGER, S.D. 1989. Effects of Meloidogyne incognita infection on water relations of two cotton cultivars. Journal of Nematology 21 569-570.

21.005* CRIS0057873

NATURE AND EXTENT OF VARIATION IN ROOT-KNOT AND CYST NEMATODES

RIGGS R D; ROBBINS R T; SLACK D A; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK00731 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 70 to 30 SEP 87

Objectives: Characterization of the variability in root-knot and cyst nematodes; determination of the abiotic and biotic factors that modify population dynamics of root-knot and cyst nematodes.

Approach: Two populations each of M. incognita will be grown on three hosts at 4 temperatures. At intervals populations will be tested differentials to test for changes in parasitic capabilities. Meloidogyne incognita and Heterodera glycines will be cultured on various hosts with soil additives. Again, the populations will be tested at intervals to check for changes in parasitic capabilities. Races 3 and 4 of H. glycines will be cultured on good hosts, treated with "contact" nematicides then planted to resistant varieties. Various rates of nematicide will be tested as well as repeated treatments. A series of cultivars of soybeans including resistant resistant and susceptible cultivars will be inoculated with H. glycines or M. incognita or both. After time for one, two or three generations the progeny will be tested on a preselected group of differentials to determine what the parasitic capabilities are and if there have been any changes. Matings between H. glycines and closely related species will be made and the progeny will be checked for changes in parasitic capabilities.

Progress: 87/01 to 87/12. Test of 80 soybean cyst nematode (SCN) populations from several states and three other countries revealed representatives of races 1, 2, 3, 4 and 5 plus six other races which have not been described. Several populations reproduced on Bedford soybean, not a differential. These were from fields where Bedford had been grown 1-3 years. Uniform race tests using differentials from Arkansas, Illinois and North Carolina revealed that the PI 88788 line used in Arkansas was not really PI 88788. This emphasized the importance of uniform differentials from a single source. Isozyme analyses from several cyst species and SCN races indicated that they can be used to separate species but not races. Mitochondrial DNA analyses showed promise for separating SCN races. Ultrastructure studies on Forrest and Bedford soybeans revealed two types of resistance based on the reaction of the tissue to nematode invasion. Single egg mass populations of a Meloidogyne sp. from a soybean field showed considerable variability in host differential response.

Publications: 87/01 to 87/12

SHILLING, K. 1981. Life cycle studies of variants of the soybean cyst nematode, Heterodera glycines. M.S. Thesis. University of Arkansas, Fayetteville.

RIGGS, R.D., HAMBLEN, M.L. and RAKES, L. 1981. Infra-species variation in reaction to hosts in Heterodera glycines populations. J. Nematol. 12:171-179.

RIGGS, R.D., RAKES, L. and HAMBLEN, M.L. 1982. Morphometric and serologic comparisons of a number of populations of cyst nematode. J. Nematol. 14:188-199.

RIGGS, R.D. (Ed.) 1982. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.

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Bull. 276.
SLACK, D.A. and RIGGS, R.D. 1982. The bud and leaf nematodes. Pp. 180-182. In R.D. Riggs, ed. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.
KIM, Y.H., KIM, K.S. and RIGGS, R.D. 1984. Structural changes associated with resistance of soybean to Heterodera glycines. Proc. 1st Internat. Cong. Nematol. p. 43. (Abstr.).

21.006* CRIS0098267
QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESS

RDBERTS P A; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4620-RRProject Type: HATCH
Agency ID: CSRS Period: 01 DCT 85 to 30 SEP 89

Objectives: Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: Relate soil initial densities of nematodes and pathogens in field plots to disease, infection, plant growth and yield parameters of field and vegetable crops. Calculate cost/efficacy functions for nematode management inputs, e.g., nematicide and resistant cv. from field experiments for root-knot nematodes in cotton, tomato, and other crops using standard nematode-crop experimental procedures.

Progress: 87/01 to 87/12. Studies continued examination of root infection ratings based on root gall indices as a quantitative predictor of yield loss. Several data sets of Meloidogyne incognita infecting cotton and tomato were collected and analyzed for relationships between amount of root galling (WNR) at end of Crop Year 1 with soil initial population densities in Crop Year 2 (Pi2) (R values ranged from 0.53 to 0.98), with relative yield in Crop Year 2 (Y2)(R from 0.53 to 0.98), and for Pi2 with Y2 (R from 0.54 to 0.97). These relationships were described by linear or more often quadratic functions. Impact on the relationships of resistant cultivar for tomato and cotton and of Fusarium wilt for cotton were found to be significant. Field validation tests for commercial implementation of root gall assays in cotton were started in a 60 acre block.

Publications: 87/01 to 87/12
BENEDICT, J.H., EL-ZIK, K.M., GUTIERREZ, A.P., DLIVER, L.R., RDBERTS, P.A. and WILSDN, L.T. 1988. Economic injury levels for cotton pests. Chapter 6. Integrated Pest Management Systems and Cotton Production.

21.007* CRIS0131246
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

KINLOCH R A; Agri Res & Education Center; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02624 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: The seasonal population dynamics of root-knot nematodes will be monitored in replicated field plots planted to soybean, sorghum, cotton, and maize. Post-harvest samples of nematodes from the different crops will be examined morphologically to determine distribution changes among the populations.

Progress: 87/10 to 88/09. The relative pathogencities of populations of Meloidogyne incognita and M. arenaria were compared to six soybean cultivars in tests conducted in replicated (X6) field plots and in greenhouse experiments using a pruned soybean technique (single cotyledon). Pruned soybean plants were separately inoculated with 868+-60 incognita juveniles and 1027+-48 arenaria juveniles. After approximately 1 month, three levels of susceptibility were recognized among the cultivars inoculated with incognita: Pioneer 9751, Centennial, and Gordon were the least susceptible, averaging 12 galls per g root. Bedford and Braxton averaged 49 galls, and S69-96 had 75 galls. In the field only S69-96 (gall rating of 2.6) could be separated from the other cultivars which had an average gall rating of 0.6. No levels of susceptibility and could be identified among the cultivars exposed to arenaria in the greenhouse (experimental mean of 190 galls per g root). In the field, however, Gordon (1.3) and Braxton (1.8) were significantly less galled than Bedford (2.4) and Pioneer 9751 (2.5). The most susceptible were Centennial (3.0) and S69-96 with a gall rating of 3.4.

Publications: 87/10 to 88/09
ND PUBLICATIONS REPORTED THIS PERIDD.

21.008* CRIS0142342
INTEGRATING CONSERVATION TILLAGE & PEST MANAGEMENT WITH IRRIGATED COTTON, SOYBEAN AND TRITICALE

DOWLER C C; JOHNSON A W; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 0500-21010-002-29D
Project Type: INHDUSE
Agency ID: ARS Period: 01 DCT 87 to 30 SEP 91

Objectives: To utilize irrigation application technology with new and improved integrated pest management systems for controlling weeds, nematodes, insects, and diseases in a multiple-cropping system of triticale-cotton-soybean grown under irrigated conservation tillage.

Approach: Multiple-cropping sequences of triticale-soybean, triticale-cotton or triticale-cotton-triticale-soybean will be studied. Experiments will integrate optimum and minimum pest management levels on the sequences grown in conservation tillage, and measure the allelopathic and residue management factors of triticale, cotton, and soybean. Soil pest population dynamics will be studied. Irrigation application technology will be utilized to apply crop production materials. Economic profitability, mathematical programming, and simulation models will be developed.

Progress: 87/10 to 87/12. Four tillage treatments (ridge-plant, no-till, row-till, deep-turn) were established on a winter crop of triticale following cotton. Yields of triticale from deep turn plots were 22% greater than yield from ridge-plant plots. Following triticale harvest, the residue was mowed tall (61 cm), mowed short (20 cm), or burned. Cotton (McNair 235) was planted in plots with the four tillage treatments. Yields from plants in deep-turn, row-till, and ridge-plant plots were 27%, 13%, and 7% greater, respectively, than yield from no-till plots. Triticale and cotton yields were affected by previous intensive cropping systems. Yield of cotton and nematode population densities were not affected by triticale residue management. Fenamiphos in combination with fluometuron or metribuzin increased injury to cotton and soybean, respectively. Irrigation application technology was successfully used to apply fertilizer, herbicide, nematicide, and insecticide.

Publications: 87/10 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

21.009* CRIS0099920
INTEGRATING CONSERVATION TILLAGE INTO PEST MANAGEMENT LEVELS WITH CROP PRODUCTION SYSTEMS

JOHNSON A W; Plant Pathology; University of Georgia, Tifton, **GEORGIA** 31794.
Proj. No.: GEO-02-0227 Project Type: STATE
Agency ID: SAES Period: 01 OCT 86 to 30 SEP 89

Objectives: Develop integrated pest management systems utilizing conservation tillage in crop production systems in the Southeastern Coastal Plain.

Approach: Three cropping sequences of soybean, cotton, and triticale (1-year double cropping sequence of soybean-triticale; 1-year double cropping sequence of cotton-triticale; and a 2-year cycle of cotton-triticale-soybean-triticale) will be established under conservation tillage (at least 30% of the preceding crop residue will be maintained at or near the soil surface), irrigation, and optimum and minimum pest management levels. Nematode population densities, root-gall indices, soil-borne pathogens, weeds, and insects will be monitored on monthly or other predetermined schedules. Crop response parameters such as stand, growth characteristics, quality, and yield will be measured. The research will be conducted in cooperation with plant pathologists, horticulturists, weed scientists, agronomists, entomologists, agricultural engineers, pesticide residue chemists, and economists.

Progress: 87/01 to 87/12. Ridge-plant, no-till, row-till and deep-turn tillage treatments were established on triticale (T) following cotton (C). Yields of T from deep-turn, row-till, and ridge-plant were 24%, 13%, and 2% greater, respectively, than yield from no-till treatment. After harvest of T, the stubble residue was mowed tall (60 cm), mowed short (20 cm), or burned. C 'McNair 235', resistant to Meloidogyne incognita, was planted on tillage treatments as described for T. Numbers of spiral nematodes, Helicotylenchus dihystera, ranged from 145 to 775/150 cm soil on T and 145 to 1100/150 cm on C, but were not affected by tillage methods or residue management. Three cropping systems, T-C; T-soybean (SB); and T-C-T-SB were established under irrigation and optimum (fenamiphos

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

21.010* CRIS0078826
ENTOMOPATHOGENS FOR USE IN PEST MANAGEMENT SYSTEMS

FUXA J R; Entomology; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02034 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To identify, characterize and standardize entomopathogens and entomopathogenic formulations to be used in regional trials of efficacy. To determine and analyze the physical and biotic factors that regulate epizootics of entomopathogens. To establish regional procedures and protocols required to maximize the utility of entomopathogens in pest management systems.

Approach: (Obj. 1) Isolates of Spodoptera frugiperda nuclear polyhedrosis virus (NPV) will be bioassayed for virulence and subjected to restriction endonuclease analysis. Repeated passage of virus in host will be used to select for increased virulence. (Obj. 3) Mathematical models will be developed for explanation or prediction of NPV epizootics in S. frugiperda populations. This effort will focus on immigration and resistance to disease and will identify specific questions for experimentation. Dispersion, certain abiotic factors, transmission to host in corn, and effects on populations of young insects will be investigated experimentally. (Obj. 4) Cultural methods will be investigated to enhance prevalence of NPV in S. frugiperda infesting pastures and corn. Sampling will be continued at sites where a Brazilian NPV was released for control of Anticarsia gemmatalis.

Progress: 87/01 to 87/12. The nematode Steinernema feltiae was evaluated as a control agent for fall armyworm (FAW), Spodoptera frugiperda, in field corn. A dose of 10 nematodes/acre resulted in 29% infection, whereas 10 nematodes/acre resulted in only 3%

infection. Spray appliation of the nematodes in 60 vs. 30 gal. water/acre did not affect % infection. Treatment with nematodes did not reduce FAW numbers compared to control plots, though results were affected by light FAW populations and a tropical storm. Vertical transmission was studied in FAW nuclear polyhedrosis virus (NPV) in order to improve microbial control. One group of FAW was fed the LD(50) of the Louisiana NPV, and another the LD(50) of a Puerto Rican isolate. The survivors were reared to the adult stage and mated. The next generation of FAW exposed to the Louisiana isolate had no infected insects, but 1% of the Puerto Rico group were killed by NPV. A subsequent experiment had 3 experimental groups: 1. FAW exposed to a dose of NPV slightly higher than the LD(50); 2. FAW again exposed to the LD(50) of the Puerto Rican isolate; and 3. the same treatment as group 2, except that the eggs of the mated survivors were washed in NaC10 solution. In the F(1) generation, infection rates were 0.4% in Group 1, 1.1% in Group 2, and 0.4% in Group 3. Percentages of infection were based on a total of 6,853 FAW in the 2 experiments; thus, confidence in vertical transmission as a real phenomenon is increasing in spite of the low percentages.

Publications: 87/01 to 87/12

FUXA, J.R. 1987. Ecological considerations for the use of entomopathogens in IPM. Annu. Rev. Entomol. 32:225-251.

FUXA, J.R. and TANADA, Y. (Eds.). 1987. Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. 555 pp.

FUXA, J.R. and TANADA, Y. 1987. Epidemiological concepts applied to insect epizootiology. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 3-21.

FUXA, J.R. 1987. Epidemiological concepts applied to insect epizootiology. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 23-41.

TANADA, Y. and FUXA, J.R. 1987. The pathogen population. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 113-157.

DAIGLE, C.J., BOETHEL, D.J. and FUXA, J.R. 1987. Parasitoids and pathogens of green cloverworm (Lepidoptera: Noctuidae) on an unclutivated spring host (Vicia spp.) and a cultivated summer host (soybean, Glycine max (L.) Merrill).

FUXA, J.R. and YEARIAN, W.C. 1987. Viruses. In C.W. McCoy (Gen. Ed.), Microbial Agents for Use in Integrated Pest Management Systems. An Overview Emphasizing Research Accomplishments for Regional Project S-135, 1978 to 1983.

21.011* CRIS0131303

IDENTIFICATION, BIOLOGY, AND MANAGEMENT OF AGRICULTURALLY IMPORTANT PLANT PARASITIC NEMATODES

MCGAWLEY E C; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.

Proj. No.: LAB02587 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 SEP 91

Objectives: To identify nematode genera, species, and races parasitic on major Louisiana crop plants. To evaluate the influence of other major plant pest groups on nematode population ecology and pathogenicity. To investigate methods useful in reducing nematode-related plant injury.

Approach: Nematode survey, greenhouse host differential testing for nematode race identification, light microscopy of nematode and plant characteristics. Field plot experiments, microplot research. Laboratory, greenhouse, and field experimentation with natural and synthetic nematicides.

Progress: 87/01 to 87/12. In numerical order, with the frequency of detection indicated in parentheses immediately after, the distribution of the five known races of the Soybean Cyst Nematode (as represented by 162 soil samples collected from the 13 major soybean producing parishes) in Louisiana is as follows: race 1 (7); race 2 (24); race 3 (68); race 4 (30); race 5 (15) and, questionable race (18). Results of greenhouse studies conducted to assess the interaction or lack thereof between the Soybean Cyst Nematode and the Red Crown Rot disease pathogen, Calonectria crotalariae, indicates that the reproduction f each organism is augmented in the presence of the other. Disease effects are additive. Penetrsation of root tissues of cyst nematode resistant plants is significantly increased when it is infected with the fungus. Race 2 of Meloidogyne incognita (Mi-2) is the most common one associated with soybeans in Louisiana. Cultivars which contain resistance to this nematode are available. Cultivars with resistance to Mi-2, but which are severely galled have been observed under field conditions with increasing frequency during the last two years. These cultivars contain both Mi-2 and M. iavanica.

Publications: 87/01 to 87/12

OVERSTREET, C. and MCGAWLEY, E.C. 1987. Influence of Calonectria crotalariae on reproduction of Heterodera glycines on resistant and susceptible soybeans. Journal of Nematology. (In press).

RUSSIN, J.S., LAYTON, M.B., BOETHEL, D.J., MCGAWLEY, E.C. SNOW, J.P. and BERGGREN, G.T. 1987. Interactions of Heterodera glycines with Diaporthe phaseolorum var. caulivora and insect-induced defoliation on soybean.

RUSSIN, J.S., LAYTON, M.B., MCGAWLEY, E.C. BOETHEL, D.J. and SNOW, J.P. 1987. Interactions between soybean looper, stem canker fungus, and soybean cust nematode on soybean. Phytopathology 77: (In Press).

LAYTON, M.B., RUSSIN, J.S., MCGAWLEY, BOETHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Effects of insect-induced defoliation, stem canker disease, and soybean cyst nematode on soybean growth and N(2) fixation.

MCGAWLEY, E.C. and WINCHELL, K.L. 1987. Greenhouse reproduction of single and combined Meloidogyne incognita and M.

javanica on soybean. Journal of Nematology 19: (In Press).

21.012 CRIS0141558
GERMPLASM ENHANCEMENT IN COTTON WITH THE PRIMITIVE RACES OF GOSSYPIUM HIRSUTUM

JENKINS J N; MCCARTY J C; SHEPHERD R L; Agricultural Research Service, Mississippi State, **MISSISSIPPI** 39762.
Proj. No.: 6406-21220-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 FEB 87 to 01 FEB 92

Objectives: Convert primitive race stocks to day neutral habit and release. Evaluate the collection with special emphasis on pest resistance, enter data into GRIN. Develop and release fertile day neutral lines with pest resistance. Develop needed methodology.

Approach: Determine flowering status of collection. Cross race lines with cultivars in winter nursery Tecoman, Mexico. Grow F2 in Mississippi and select day neutral types. Continue through 3-4 backcrosses. Evaluate race lines for resistance to root knot nematodes (RKN) using greenhouse procedure. Eval- uate converted lines for pest resistance, particularly tobacco budworm. Enter data into GRIN. Utilize contract with Auburn University for regional fusarium wilt-RKN nursery for evaluation of breeder strains and cultivars from across Cotton Belt. Develop and release pest resistant day neutral lines as well as converted day neutral race lines.

Progress: 87/01 to 87/12. Developed 19 strains in 5 cultivar backgrounds resistant to RKN and equal to parental cultivars in agronomic performance. Germplasm release made of 12 days neutral primitive race lines containing RKN resistance. Screened 54 primitive race lines for RKN resistance. Five have a useful level of resistance to RKN. PIX consistently reduced the mainstem nodes and produced shorter plants when applied to a diverse group of photoperiodic race lines. Seed increases preparatory to germplasm releases were made for 2 F3, 4 BC2F3, 39 BC3F3 and 19 BC4F3 day neutral lines of primitive races. Day neutral selections were made in 39 F2, 22 BC3F2, and 17 BC4F2 progeny in the conversion program. Three-day neutral germplasm pools involving several lines were increased. Six of 7 DN lines evalauted for boll weevil oviposition were resistant. Evaluated 39 new DN race lines and reevaluated 23 DN race lines for TBW resistance in field plots with and without TBW. Data not analyzed at this time.

Publications: 87/01 to 87/12
MCCARTY, J.C., Jr., JENKINS, J.N., and PARROTT, W.L. 1987. Genetic resistance to boll weevil oviposition in primitive cotton. Crop Sci. 27:263-264.
MCCARTY, J.C., Jr., JENKINS, J.N., SHEPHERD, R.L., and PARROTT, W.L. 1987. Vegetative growth response of primitive cotton race stocks to PIX. Miss. Agric. and For. Exp. Stn. Research Report 12(15). 3 pp.

21.013 CRIS0140545
GENETIC ENHANCEMENT FOR RESISTANCE TO INSECTS, NEMATODES, AND DISEASES IN COTTON

JENKINS J N; PARROTT W L; SHEPHERD R L; Cotton Host Plant Resist Res Crop Science Res Lab; Agricultural Research Service, Mississippi State, **MISSISSIPPI** 39762.
Proj. No.: 6406-21220-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Develop means for maintaining and increasing productivity and quality of cotton by developing genetic populations of germplasm with host plant resistance to insects, nematodes and diseases. Broaden germplasm resources through converting the Gossypium hirsutum race collection to day neutral status. Develop germplasm pools of converted race stocks.

Approach: Develop germplasm resistant to specific pests. Combine resistance to multiple pests. Elucidate common pathways involved in genetic resistance to insects, nematodes, and diseases. Determine the morphological and biochemical charcters in cotton, including the exotic races, that confer plant resistance to pests: Heliothis spp., boll weevil, plant bug, nematodes, fusarium and verticillium wilts. Determine the biochemical and pathogenesis mechanisms involved in plant-pest interactions. Utilize this in genetic programs to develop germplasm resistant to pests.

Progress: 87/01 to 87/12. Released 8 germplasms tolerant to TBW. Several cultivars evaluated for RKN resistance. All highly susceptible with 76,000 to 164,000 RKN eggs per plant compared to 1200 on resistant plants. Cooperative field test of RKN resistant strains conducted in GA, AL, MS, and CA. Lines developed for RKN resistance only were evaluated in the Regional Wilt Nursery averaged 30% wilting compared to 63.5% for the resistant check. These were more resistant to FW than 22 sets of lines from cooperators. Evaluated 96 lines for resistance to TBW based on larval growth. From our program 24 were resistant to TBW. From the Regional TBW test 12 of 14 produced smaller larvae than the control. In the Regional Short Season test 4 of 17 produced small worms. Only 1 high tannin line produced worms smaller than control. When TBW larvae were put in terminals on 5, 11, and 14 node plants, harvestable bolls were reduced at position 1. At the 11 and 14 node infestation more bolls were produced at position 2. Yield, but not maturity was the same as plants without TBW. TBW larvae spent 80% and 18% of their time at squares in position 1 and 2 respectively in GH. TBW pupae induced into diapause in the Lab were successfully stored over the winter in controlled environment chambers and in containers underground. In a GH study PIX treated plants produced fewer spider mites 14 days after infestation. A TBW strain resistant to synthetic pyrethroids was not more tolerant to gossypol.

Publications: 87/01 to 87/12

GRAHAM, C.T., JR., JENKINS, J.N., MCCARTY, J.C., and PARROTT, W.L. 1987. Effects of mepiquat chloride on natural plant resistance tobacco budworm in cotton. Crop Sci. 27:360-361.
MCCARTY, J.C., JR., and MCGOVERN, W.L. 1987. Oviposition preference in two laboratory colonies of boll weevils (Coleoptera: Curculionidae). J. Econ. Entomol. 80:366-368.
MCCARTY, J.C., JR., JENKINS, J.N., HEDIN, P.A., SHEPHERD, R.L., and PARROTT, W. L. 1987. The effects of plant growth regulators on cotton yield in two environments. Miss. Agric. and For. Exp. Stn. Res. Rpt. 12(13). 4 pp.
HSIEH, C., JENKINS, J.N., MCCARTY, J.C., JR., SHEPHERD, R.L., and PARROTT, W.L. 1987. Breeding potential of cotton germplasm tolerant to tobacco budworm Heliothis virescens (Fab.). Miss. Agric. & For. Exp. Stn. Tech. Bull. 144. 7 pp.
JENKINS, J.N., et al. 1987. Notice of release of three noncommercial germplasms of upland cotton tolerant to tobacco budworm, and the tarnished plant bug. Official Release of ARS and Miss. Agric. & For. Exp. Stn. 3 pp.
JENKINS, J.N., et al. 1987. Notice of release of two noncommercial germplasms of upland cotton tolerant to tobacco budworm. Official Release of ARS and Miss. Agric. and For. Exp. Stn. 3 pp.
JENKINS, J.N., et al. 1987. Notice of release of three noncommercial germplasms of upland cotton tolerant to tobacco budworm. Official Release of ARS and Miss.

21.014 CRIS0140723

GENETIC RESISTANCE TO PLANT BUGS, HELIOTHIS SPP., SEEDLING DISEASES, BOLL ROT, AND WILTS OF COTTON

MINTON E B; BAILEY J C; Cotton Physiology & Genetics Research Unit; Agricultural Research Service, Stoneville, **MISSISSIPPI** 38776.
Proj. No.: 6402-21220-001-00D Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Perfect techniques in the laboratory and field that identify genotypes withresistance to Lygus, Heliothis, seedling diseases, boll rot, and wilts of cotton. Determine heritability of resistance. Develop improved pest resistant germplasm and develop an improved crop management strategy using resistant germplasm as an integral part of management.

Approach: Develop new techniques in which genetic variability for pest resistance canbe detected; screen germplasm for resistance; determine heritability of resistance; evaluate resistance develop an improved crop management strategy utilizing pest resistant traits.

Progress: 87/01 to 87/12. Field weathered seed resulted in poorer plant stands and lint yields than unweathered seed. Coating seed with fungicides and increased plant populations did not completely compensate for the poor yield performance obtained from weathered seed. Yield responses to potash were not obtained. A definite seedling survival response was not obtained from seed harvested from plants treated with PREP the previous season. Coating seed with combinations of fungicides that are specific for Rhizoctonia, Pythium and Thielaviopsis showed that a three-way combination gave the highest plant stands. Pythium suppressed plant stands beltwide more than Rhizoctonia or Thielaviopsis. The latter two fungi were more important than Pythium in some tests.

Publications: 87/01 to 87/12

MINTON, E.B. 1987. Report of the cottonseed treatment committee for 1986. The Cotton Gin and Oil Mill Press. 88(6):10-13.
MINTON, E.B. 1987. Report of the cottonseed treatment committee for 1986. Proc. 1987 Beltwide Cotton Prod. Res. Conf. pp. 15-19.
MINTON, E.B., and BAILEY, J.C. 1987. Effect of Temik-Terraclor Super X on the performance of cotton cultivars. Proc. 1987 Beltwide Cotton Prod. Res. Conf. p. 551.
MINTON, E.B., and MEREDITH, W.R., JR. 1987. Root-knot nematodes effect on nine cotton cultivars in Mississippi. Crop Sci. 27:1001-1004.
CATHEY, G.W., and BAILEY, J.C. 1987. Evaluation of chlordimeform for cotton yield enhancement. J. Econ. Entomol. 80:670-674.
MINTON, E.B., and BAILEY, J.C. 1987. Performance of cotton cultivars grown with and without Temik plus Terraclor Super X. Proc. Ann. Meeting Miss. Assoc. Plant Pathologists and Nematologists. (Accepted February, 1987).

21.015* CRIS0089894

QUANTIFYING THE PARAMETERS OF THE NEMATODE PEST MANAGEMENT DECISION PROCESS

THOMAS S H; Entomology & Plant Pathology; New Mexico State University, Las Cruces, **NEW MEXICO** 88003.
Proj. No.: NM-1-5-27174 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: The effects of edaphic factors on nematode-related crop losses in vegetables, cotton and sorghum will be studied under field conditions. Greenhouse and microplot experiments will be used to rapidly identify germ-plasm-related differences in susceptibility and inoculum influences. The relationship of chemical and cultural control practices to nematode-related crop loss functions will be determined. From this, economic thresholds will be developed for Meloidogyne incognita and Pratylenchus spp. on cotton, sorghum and locally important vegetables.

Progress: 86/10 to 87/12. Acala 1517-E2 cotton and DK 57 grain sorghum yields were reduced 58% and 46% respectively in microplots infested with Meloidogyne incognita host race 3 compared to uninfested plots. Early season plant height was reduced and bloom date delayed in infested sorghum plots, but not in cotton. Aldicarb (1.68 kg a.i./ha) afforded significant control of J2 populations in soil during the first two months of cotton culture, but only 54 liters/ha 1,3-dichloropropene resulted in season-long control in both crops. Net benefits from cotton nematicides (revenue from yield increase associated with nematicide application, less treatment costs) were $274/ha with 1,3-D, $124/ha with fenamiphos (1.85 kg a.i./ha) and $30/ha with aldicarb. Sorghum net benefit was $23/ha with application of 1.12 kg a.i./ha carbofuran, but yield responses with 1,3-D and aldicarb were not cost effective. Residual M. incognita inoculum was 14 x greater in sorghum plots than cotton. Field plot experiments demonstrated a 24% increase in chile pepper yields by increasing depth of placement of 1,3-D from 25 cm (normal placement depth in NM) to 48 cm in sandy loam soils. This results in a $642/ha ($260/acre) increase in net benefit from application. Depth of placement studies were repeated during 1987 and net benefits compared with nonfumigant nematicides. Additional studies were initiated to investigate the interrelationships of phytophagous insects and plant-parasitic nematodes on common host.

Publications: 86/10 to 87/12

ALVAREZ, M.E., SENGUPTA-GOPALAN, C., THOMAS, S., KUEHN, G.D. and KEMP, J.D. 1987. Isolation and characterization of a collagenase that degrades nematode collagen. Proceedings Southwest Consortium on Plant Gentics and Water Resources.

KLUMP, R.S. and THOMAS, S.H. 1987. Comparative resistance of selected Acala 1517 cotton cultivars to Meloidogyne incognita race 3. Annals of Applied Nematology 1:113-115.

THOMAS, S.H. and MURRAY, L. 1987. Yield reductions in grain sorghum associated with injury by Meloidogyne incognita race 3. J. Nematology 19:559. (Abstract).

THOMAS, S.H. 1987. Nematodes in chile: enhancing control by increasing placement depth of Telone II. Proceedings New Mexico Chile Conf.

THOMAS, S.H. and SHANNON, E.L. 1987. Nematode disease losses in New Mexico cotton. Proceedings Beltwide Cotton Production Research Conferences. P. 10.

21.016 CRIS0134847
COTTON BREEDING

BOWMAN D T; Crop Science; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06064 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Develop open-pollinated cotton cultivars adapted to North Carolina. Specifically, cultivars will be bred with higher lint strength, greater seedling vigor, and higher yield than currently available. Resistance to root-knot, reniform, and Columbia lance nematodes will be incorporated. Earliness will be considered in any cultivar released.

Approach: A recurrent selection program will be followed utilizing genotypes currently adapted to North Carolina as well as sources of high lint strength, seedling vigor, earliness, and resistance to root-knot and reniform nematodes. Cotton germplasm will be screened for resistance to the Columbia lance nematode.

21.017 0138839
BIOLOGY AND MANAGEMENT OF NEMATODES ON SOYBEAN AND COTTON

SCHMITT D P; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06108 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine aspects of host phenology responsible for diapause in H. glycines; Characterize fitness of H. glycines genotypes to reproduce and survive periods of nonhost; Develop crop production systems that reduce survival and decrease population densities of Heterodera glycines; Characterize the damage functions for Hoplolaimus columbus, Rotylenchulus reniformis, and Paratrichodorus minor on cotton; and evaluate cotton germplasm for resistance to Hoplolaimus columbus.

Approach: Several cropping systems will be evaluated in fields infested with Heterodera glycines to determine which ones will keep populations at a low level. The genetic fitness of this nematode to survive will be characterized using controlled matings then exposing the progeny to a winter environment. Nematode damage functions on cotton will be elucidated in the field in plots selected to give a range of population densities from zero to very high. Cotton germplasm will be evaluated for resistance to Hoplolaimus columbus using a standard inoculum density in the greenhouse.

21.018* CRIS0088272
TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology. Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of

Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Ouchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09

RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.

RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

21.019* CRIS0132029

MORPHOLOGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDOGYNIDAE

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

21.020 CRIS0132473

RESPONSE OF COTTON TO HOPLOLAIMUS COLUMBUS POPULATIONS FROM NORTH AND SOUTH CAROLINA

MUELLER J D; LEWIS S A; SCHMIDT D P; Plant Pathology & Physiology; Blackville, **SOUTH CAROLINA** 29817.
Proj. No.: SC-2-3050Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 87 to 31 AUG 89

Objectives: To determine response of cotton to populations of Hoplolaimus columbus, relative aggressiveness of H. columbus from two locations, soil temperature effect on H. columbus reproduction & plant growth, and morphological and cytological differences of four isolates of H. columbus.

Approach: Field plots with 400 1-m row lengths will be marked in each cotton field. Soil cores will be extracted from each plot and six plots from each chosen infestation level will be evaluated for yield. Initial populations isolated from the field plots will be evaluated in yield microplots. Two weeks after emergence plant roots will be stained and examined for nematodes. Seed and lint yields and shoot and root dry weights will be taken at maturity. Initial populations of 0, 25, 50, 100, 200, 400, 800, 1600, and 3200/100 cm soil and temperatures of 14/18 C, 22/26 C, and 32/36 C (diurnal, day/night temperature) will be evaluated for their effect on shoot and root fresh and dry weights and nematode reproduction at the Phytotron. Morphological and cytological assays of four isolates of H. columbus will be prepared and correlated with pathogenicity.

21.021* CRIS0131089
DISTRIBUTION, ECOLOGY AND PATHOGENICITY OF ROOT-KNOT NEMATODE (MELOIDOGYNE SPP.)

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01225 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 87 to 30 MAR 92

Objectives: Determine the subspecific identity of geographical isolates of Meloidogyne spp. in soybean, cotton, and tobacco; determine environmental and edaphic conditions under which physiologic development is favored; and evaluate various host and nonhost plants for nematode management in potential cropping systems.

Approach: Geographical isolates of Meloidogyne incognita and M. arenaria will be identified using host differential plants, perineal patterns of females, male lip shape, cytology, and esterase enzyme profiles. Soil structure, moisture, and temperature relationships will be assessed for their importance in reproduction and aggressiveness of several M. incognita isolates. Life tables will be constructed after determining activity and developmental thresholds of the isolates. Physical and moisture characteristics of two soils will be studied for their influence on egg hatch, movement, invasion, and reproduction. The host suitability of different cultivars of corn, wheat, and sorghum will be assessed against selected isolates of M. incognita. Mass screening of nematode isolates and plant cultivars will be done in the greenhouse and field. This information will be used to develop an economic model of root-knot nematode management.

Progress: 87/04 to 87/12. Greenhouse and laboratory experiments were performed to determine if an interaction exists between Meloidogyne incognita and Hoplolaimus columbus on Davis soybean. Greenhouse tests were performed with three population levels of M. incognita and H. columbus (0, 15,00, 6,000/1.5-liter pot) separately and in all combinations. Dry root weight (DRT) declined nonlinearly and dry shoot weight (DST) declined linearly with respect to increasing initial populations of M. incognita and H. columbus. When the two nematode species were added to the soil together, the amount of DRT and DST suppression by one species was dependent on the initial level of the concomitant species. The final root population of M. incognita or H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus suppressed M. incognita populations in the soil nonlinearly, but M. incognita had no effect on H. columbus. In other tests, using root explants of M. incognita-susceptible Davis and M. incognita-resistant Centennial, roots parasitized by M. incognita are more attractive to H. columbus than roots of susceptible, and especially M. incognita-resistant soybean ccultivars infected by H. columbus. In susceptible Davis, H. columbus is not only attracted to M. incognita-infected roots but also penetrates these roots more readily than noninfected roots.

Publications: 87/04 to 87/12
GUY, D.W., JR. and LEWIS, S.A. 1987. Selective migration and root penetration by Meloidogyne incognita and Hopololaimus columbus on soybean roots in vitro. J. Nematol. 19:390-392.
GUY, D.W., JR. and LEWIS, S.A. 1987. Interaction between Meloidogyne incognita and Hopolaimus columbus on Davis soybean. J. Nematol. 19:346-351.

21.022 CRIS0134541
MANAGEMENT OF HOPLOLAIMUS COLUMBUS NEMATODE ON COTTON AND SOYBEAN

MUELLER J D; Plant Pathology & Physiology; Edisto Res & Educ Center, Blackville, **SOUTH CAROLINA** 29817.
Proj. No.: SC01265 Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 88 to 30 DEC 92

Objectives: Determine damage functions for H. columbus on cotton and soybean. Compare pathogenicity of geographic isolates of H. columbus from North Carolina and South Carolina on cotton and soybean. Screen cotton germplasm for resistance or tolerance to H. columbus. Determine chronology, location, and affects of early season infection of cotton and soybean by H. columbus. Determine spatial distribution, overwintering sites, and lifestages of H. columbus in the soil.

Approach: Variation in pathogenicity of H. columbus and levels of host plant resistance will be evaluated using damage functions.

21.023 CRIS0142136
PHYSIOLOGY OF NEMATODES AND THEIR INTERACTION WITH CROP PLANTS

VEECH J A; THOMAS M D; Agricultural Research Service, College Station, **TEXAS** 77843.
Proj. No.: 6202-24000-006-00D
Project Type: INHOUSE
Agency ID: ARS Period: 17 FEB 87 to 16 FEB 92

Objectives: To elucidate the biological activity and chemical composition of nematode stylet exudate from plant parasitic nematode species, activities and chemicals related to host plant susceptibility and resistance and nematode pathogenicity will be emphasized.

Approach: Biological activity of stylet exudate will be assessed by treating host cells with stylet exudate and monitoring cellular responses with a time-lapse VCR linked to an interference contrast microscope. Treated cellswill be analyzed for specific enzymes and natural products using standard histochemical methods; weak responses will be measured with a microspectrophotofluorometer mounted on a visible-fluorescent microscope.

Exudate-producing nematodes will be placed in microscope perfusion chambers, and accumulated exudate will be analyzed by microchemical methodsusing the microscope-photometer. Exudate mechanically removed from nematodes will be analyzed by electrophoresis and other micromethods.

Progress: 87/02 to 87/12. Fundamental parameters of in vitro accululation of stylet exudate were worked out and reported in the listed publication. Exudate accumulation was recorded with a VCR, and biological activity studies based upon the topical application of stylet exudate to host cells were conducted. Early stages of giant cell formation were not detected; similar studies, based upon microinjection of stylet exudate into host cells, are scheduled. Efforts to react fluorescent antibodies with stylet exudate antigen were only marginally effective; the fluorescent marker was detected, but not consistently, in stylet exudate accumulated at the oral aperture of M. incognita females excised from tomato roots. Preliminary studies indicate the presence of nucleic acid in stylet exudate; this result is being pursued with additional studies.

Publications: 87/02 to 87/12

VEECH, J.A., STARR, J.L., and NORDGREN, R.M. 1987. Production and partial characterization of stylet exudate from adult females of Meloidogyne incognita. J. Nematol. 19: 463-468.

21.024* CRIS0131690

BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

STARR J L; Plant Pathology & Microbiology; Texas A&M University, College Station, **TEXAS** 77843.
Proj. No.: TEX07121 Project Type: HATCH
Agency ID: CSRS Period: 08 MAY 87 to 30 SEP 91

Objectives: 1. To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: Field microplots will be infested with a population of race 3, race 4, or both of M. incognita. A rotation system of cotton, sorghum, and resistant soybeans will be imposed on each plot. After each growing season several single egg mass isolates from each treatment will be collected and increased on tomato. Resulting populations will be race typed to determine rates of change in race status, if any. In arid regions various skip row planting systems are sued to conserve limited soil moisture. The use of a precision planting system, whereby rows to be planted are always placed over rows fallowed the previous year, will be tested to determine possible benefits in nematode control.

Progress: 87/05 to 87/12. This is a newly established regional project and few studies are yet complete; current project activities are centered on two approaches to management of root-knot nematodes. The first approach is a cultural method whereby skip-row planting systems used to conserve soil moisture in arid regions will be exploited to suppress nematode populations. Long-term (3 yr) experiments have been established to examine the benefit of planting only over rows fallowed the previous year in the skip-row planting system. The other approach to management is the development of root-knot resistant cultivars in crops that are attractive as rotational crops for soybean. Peanut is naturally resistant to soybean cyst nematodes and Meloidogyne javanica and M. incognita. If resistance to M. hapla and M. arenaris can be incorporated into acceptible peanut cultivars, then peanut would be an acceptable rotational crop for soybean. We have begun screening exotic Arachis species germplasm for useful sources of resistance to M. arenaria and M. hapla.

Publications: 87/05 to 87/12

WIGGERS, R., STARR, J.L. and PRICE, H.J. 1987. DNA content of Meloidogyne - induced giant cell nuclei. J. Nematol. 19:562 (Abstr.).
WHEELER, T.A. and STARR, J.L. 1988. Incidence and economic importance of plant-parasitic nematodes on peanuts in Texas. Plant Science:In press.

21.025 CRIS0099704

COMBINED EFFECTS OF FUSARIUM WILT AND ROOT-KNOT NEMATODES ON PLANT MORTALITY AND YIELD OF COTTON

STARR J L; MARTYN R D; Plant Pathology & Microbiology; Texas A&M University, College Station, **TEXAS** 77843.
Proj. No.: TEX06863 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 86 to 30 JUN 89

Objectives: Principle objectives of this project are to determine the relationship between inoculum density (ID) of F. oxysporum f. sp. vasinfectum and incidence of wilt disease (DI) on cotton, and to determine the quantitative effects of root-knot nematodes on this relationship. The efficacy of different Fusarium propagule types in initiating disease will also be determined.

Approach: A factorial experimental design will be used to determine ID/DI relationships. All tests will be conducted in field microplots, both artifically and naturally infested with the fungal and nematode pathogens. Greenhouse tests utilizing laboratory reared inoculum will be used to examine inoculum efficacy.

Progress: 87/01 to 87/12. Microplot studies on the epidemiology of the Fusarium wilt/rootknot complex have continued. The complex is manifested as increased plant mortality and stunting during the season, and by suppressed seed cotton yields. Both Fusarium oxysporum f. sp. vasinfectum and Meliodogyne incognita affect plant mortality, but effects on stunting and yield are due primarily to M. incognita. Failure to detect any effect of Fusarium on yield may be due to the constraints of the microplot system. When yield response to nematode populations was analyzed by the Seinhorst model, Fusarium was found to alter

the minimum yield parameter (M) but not the threshold parameter (T). Studies are in progress to evaluate relative resistance to the disease complex among currently acceptable cotton cultivars. Studies are also in progress to determine a damage threshold for Fusarium on cotton.

Publications: 87/01 to 87/12

STARR, J.L. 1988. Relationship between population densities of Meloidogyne incognita on cotton and egg viability. Journal of Nematology 20:In press.

STARR, J.L., MARTYN, R.D. and JEGER, M.J. 1987. Microplot studies of the Fusarium wilt/root-knot complex of cotton. Proc. Beltwide Cotton Prod. Res. Conf.; Cotton Disease Council 47:53.

MARTYN, R.D., STARR, J.L. and JEGER, M.J. 1987. The Fusarium wilt/root knot disease complex in cotton: Effects on plant stunting and mortality. J. Nematol. 19:541. (Abstr).

21.026 CRIS0097052

HOST PLANT RESISTANCE IN COTTON TO INSECTS, MITES, NEMATODES AND DISEASES

BENEDICT J H; EL ZIK K M; SCHUSTER M F; Texas Agric Expt Station; Texas A&M University, Corpus Christi, **TEXAS** 78406.

Proj. No.: TEX07051 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: To continue development of efficient screening and evaluation methods, and to conduct a systematic screening program for additional sources of resistance. To develop basic breeding stocks with known sources of resistance and evaluate these on a local and regional basis. To determine the nature of resistance. To develop production programs that permit optimum use of resistance characters.

Approach: Identify and evaluate methods to systematically screen germplasm for pest resistance. Establish a program to screen for new cotton germplasm on a local and regional basis. Breed and advance agronomic genotypes with known sources of resistance. Breeding techniques will vary from conventional pedigree to exotic, genetic engineering. Laboratory, greenhouse and field techniques of studying pest behavior, population dynamics parameters, and plant damage will be utilized to identify and quantify the nature of resistance.

Progress: 87/01 to 87/12. Resistance levels were increased for bacterial blight, fleahoppers, boll weevils, bollworms, and spider mites in several new multi-adversity resistant (MAR) strains. Resistance to Pythium ultimum and Rhizoctonia solani were found to be polygenically inherited and conditioned by a complex of minor genes. A relationship was indicated between tannin content and the progressive improvement in the broad resistance to disease and insects in the MAR germplasm. In 1987, the MAR germplasm and Tamcot varieties planted 44.5% of the cotton acreage in Texas and 24% of the USA acreage. The breeding phase of the condensed tannin work was expanded significantly in 1987. A total of 634 progeny rows and strains grown at College Station were chemically evaluated for condensed tannin concentration. In a bioassay, condensed tannin was directly correlated with bollworm damage in glandless cotton. Thus, gossypol may not be necessary for developing bollworm resistance in cotton. Further, this bioassay shows promise as a method to identify resistant plants in populations segregating for high tannin. Free-chioce and no-choice plant resistance studies with boll weevil and tobacco budworm were conducted with four exotic species of Gossypium and commercial cotton. The exotic species were more resistant to both insects than commercial cotton. Exotic species of Gossypium can provide new sources of insect resistance.

Publications: 87/01 to 87/12

BENEDICT, J.H. and CHANG, J.F. 1988. Bacterially-induced changes in the cotton plant-boll weevil paradigm: A case history. In D.W. Tallamy and M.J. Raupp (eds.) Phytochemical Induction by Herbivores. John Wiley and Sons, N.Y., N.Y.

BENEDICT, J.H., TREACY, M.F., ALTMAN, D.W., and SCHMIDT, K.M. 1987. Preference of boll weevils and tobacco budworms for five species of Gossypium, pp. 92-93. In T.C. Nelson (ed.) Proc. Beltwide Cot. Prod. Res. Conf.

BIRD, L.S., EL-ZIK, K.M. and THAXTON, P.M. 1986. Registration of (Tamcot CAB-CS) Upland cotton. Crop Sci. 26:384-385.

CHANG, J.F., BENEDICT, J.H., PAYNE, T.L. and CAMP, B.J. 1988. Volatile monoterpenes collected from the atmosphere surrounding flowerbuds of seven cotton cultivars. Crop Sci. (Accepted).

CHANG, J.F., BENEDICT, J.H., PAYNE, T.L. and CAMP, B.J. 1988. Boll weevil pheromone production in response to selected cotton cultivars. Environ. Entomol. (Accepted).

CHANG, J.F., BENEDICT, J.H., PAYNE, T.L., CAMP, B.J. and VINSON, S.B. 1988. Collection of pheromone from the atmosphere surrounding boll weevils, Anthonomus grandis. J. Chem. Ecol. (Accepted).

CHANG, J.F., BENEDICT, J.H., PAYNE, T.L. and CAMP, B.J. 1987. Attractiveness of cotton volatiles and grandlure to boll weevils in the field, pp. 102-104. In. T.C. Nelson (ed.) Proc. Beltwide Cot. Prod. Res. Conf.

23.001* CRIS0014801
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

MACDONALD D H; Plant Pathology; University of Minnesota, St Paul, **MINNESOTA** 55108.
Proj. No.: MIN-22-042 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs. Determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships. Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Greenhouse rose beds will be sampled to detect changes in populations of Pratylenchus and Paratylenchus spp. Fields infested with Heterodera glycines and planted to nonhost crops will be sampled to correlate the size of the larval population with the probability for soybean crop damage the following season. Microplots will be utilized to determine the pathogenicity of different population densities of the nematode. Sampling to determine the distribution of Pratylenchus penetrans in Minnesota will be continued. Microplot, temperature tank, and field plot techniques will be utilized to compare Minnesota isolates of the nematode and their effects with the characteristics of the nematode as determined in the Northeast.

Progress: 87/01 to 87/12. Unreliable results wee obtained when advanced breeding lines of soybeans were screened for resistance to the soybean cyst nematode, Race 3, by transplanting into and growing seedlings in 10 cm diameter plastic pots filled with an infested sand-soil mix containing 500 infective larvae/pot-plant for 5 weeks. Only 4 to 11 of those larvae (0.8 to 2.2% of the original inoculum) need to infect and develop to the white female stage in order for the seedling to be rejected as being moderately to very susceptible, respectively. The reason or reasons for the low level of infection and/or development of this nematode in some genotypes that proved to be susceptible when inoculated with 2000 larvae, pot-plant is or are unknown. No relationship existed between qualitative characteristics of females that did develop from the low inoculum level of 500 larvae/pot-plant and the reaction that the plan would exhibit when inoculated with 2000 infective larvae. Xiphinema chambersi was reidentified for the first time since 1959 as an inhabitant of Minnesota soils and was postulated to be a virulent pathogen of maize in one field with sandy soil and a high water table. The pathogenicity of Longidorus breviannulatus and other migratory plant nematodes to both a lower vigor and a higher vigor Minnhybrid (5201 and 5303, respectively) growing in a fine sandy loam soil was reduced by planting the hybrids either in a ridge or in furrow compared to normal planting.

Publications: 87/01 to 87/12
SORTLAND, M.E. and MACDONALD, D.H. 1987. Effect of crop and weed species on development of a Minnesota population of Heterodera glycines Race 5 after one to three growing periods. Plant Dis. 71:23-27.

23.002 CRIS0088461
PATHOGENICITY, ECOLOGY, AND EPIDEMIOLOGY OF SOYBEAN PATHOGENS IN THE IMPROVEMENT OF SOYBEAN CULTIVARS

PACUMBABA R P; SAPRA V T; Natural Resources; Alabama Agric and Mech Coll, Normal, **ALABAMA** 35762.
Proj. No.: ALAX-011-183 Project Type: 1890/T
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: To screen and select soybean lines developed through breeding against major pestand diseases. To develop efficient inoculation techniques for each or combination of disease pathogens. To determine the ecology and epidemiology patterns of these diseases as they relate to the improvement of soybean lines.

Approach: Soybean germplasm in the F1 through F4 and in maturity groups V through VIII will be inoculated with each of the major soybean pathogens and/or pest previously iisolated and maintained in the laboratory and/or cyst infested soil in the greenhouse, screened and selected for single disease resistance, then for multiple disease resistance. Soybean lines showing single or multiple disease resistance will be recommended back to breeder as desirable parent materials in the breeding program and/or evaluated further under various ecological conditions within the state of Alabama, prior to being registered as a new soybean variety.

Progress: 86/01 to 86/12. In the Soybean Crossing Block where 207 germplasm were tested, 101 and 1 and 1 and 59 were resistant and moderately resistant to soybean stem canker (SSC) and bacterial blight (BB), respectively. Thirty soybean germplasm from Auburn University for adaptability test were also screened and 24 germplasm were resistant to SSC, while 2 and 10 were resistant and moderately resistant to BB. Rating for soybean cyst nematode (SCN) was not included because the soybean plants were planted in non-SCN infested soil. Thirteen germplasm (selected earlier) were used in the Uniform Soybean Test. Six and 13 germplasm were moderately resistant to SCN and BB, respectively, while 11 germplasm were resistant to SSC. Ratings for diseases were the following: 0 rating=resistant with 0% disease field infestation, 1-6 ratings-moderately resistant with 1-10% field infestations, and 7-9 ratings=susceptible with 11-100% field infestations (based on 0-9 disease scales with 0=no infection and 9=severe plant chlorosis and stunting or complete defoliation of leaves or the plants are dead). Eleven isolates of Diaporthe phaseolorum var. caulivora, each grown on PDA plates at different pH and temperatures in either continuous fluorescent light or dark, varies significantly in their

growth morphology, number of stroma produced, color and consistency of the culture colonies. The maximum growth rate of the isolates was obtained at pH 4.5 at 20 C in continuous fluorescent light or at pH 4.5 at 30 C in the dark.

Publications: 86/01 to 86/12

KPOGHOMOU, B., SAPRA, V., SINGH, B., RANGAPPA, M., KRAEMER, M., BHAGSARI, A., REDDY, M., PACUMBABA, R., FLOYD, M., TEWARRI, S., and IGBOKWE, P. 1986. Evaluation of soybean germplasm for stress tolerance and biological efficiency.

AL-JALILI, A.S., SAPRA, V.T., and PACUMBABA, R.P. 1986. Determination of resistance or susceptibility of soybean genotypes to soybean cyst nematode, Heterodera glycines race 3. Phytopath. Z. 114:000-000 (In press).

23.003 CRIS0096023

DEVELOPMENT OF A MICROCOMPUTER-BASED SOYBEAN PEST MANAGEMENT SYSTEM

BACKMAN P A; MACK T P; RODRIGUEZ-KABANA R; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: ALA-50-0074 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 85 to 31 DEC 88

Objectives: Define variables and conduct studies needed to further quantify the relationships between major pest abundance and soybean yield. Link the relationships developed above with near real time weather data from NOAA and migratory insect data from APHIS. Integrate the information and functions obtained into a farmer-usable computerized soybean pest management system, which will be evaluated for its ability to increase productivity and profitability of soybeans.

Approach: A microcomputer-run pest management system for soybeans that will utilize soybean growth models, equations on pest population dynamics, loss information, and weather will be developed using both published and unpublished information. When data is not available on a critical pest, research will be conducted on its population dynamics, and damage potential. Validation experiments will be conducted to determine the sensitivity of model components, and the overall benefits of this system versus standard farmer practices.

Progress: 87/01 to 87/12. Eleven field experiments were conducted over the state, using model versions improved from 1986, to continue the validation of the Auburn University Soybean Integrated Management Model. An additional eight experiments were conducted to further refine specific nematode, insect, and plant disease components. As with the 1986 season, dry weather conditions suppressed plant diseases and nematode populations, comprised yields, and totally eliminated experiments at certain substations. However, initial results indicate that 1987 model versions generally managed soybean pests profitably. Definite improvements were seen with the insect and plant disease submodels, each having ca. 85% accuracy. An initialization/cultivar selection component was developed which will aid growers in selecting cultivars best suited to their specific location, soil type, rotation and tillage system, and pest complex. Also, deveopment of the model 'shell' was begun which links all of the individual components by passing potential yield through the season, and accumulating decrements due to actual pest problems and costs of chosen management tactics. The initializer and shell programs are being written with the aid of OTT specialists and should be completed by March of 1988.

Publications: 87/01 to 87/12

HERBERT, D.A., BACKMAN, P.A., MACK, T.P., RODRIGUEZ-KABANA, R. and SCHWARTZ, M.A. 1987. Microcomputer-based soybean pest management model for maximizing profit and profitability. Highlights of agriculture. Ala. Agric. Expt. Sta.

HERBERT, D.A., BACKMAN, P.A., MACK, T.P., RODRIGUEZ-KABANA, R. and SCHWARTZ, M. 1987. A profit critical integrated pest management model for Alabama soybean. Proc. S. Soybean Disease Wkrs. 14: 89 (Abstr.)

HERBERT, D.A., SCHWARTZ, M.A. and REED, T.D. 1987. Control of soybean pests in Alabama. Insecticide and Aracide Tests. 12: 275-276.

HERBERT, D.A. and MACK, T.P. 1987. Control of lesser cornstalk borer in soybean. Insecticide and Acaricide Tests. 12: 275.

HERBERT, D.A. and MACK, T.P. 1987. Identification of lesser cornstalk borer damage to soybeans. Alabama Agricultural Experiment Station Leaflet No. 103.

HERBERT, D.A., RODRIGUEZ-KABANA, R., BACKMAN, P.A. and MACK, T.P. 1987. Effects of aldicarb on nematodes, early season insect pests and yield of soybean. Annals of Applied Nematology 1:78-83.

23.004 CRIS0091501

MANAGEMENT SYSTEMS FOR THE CONTROL OF DISEASES AND NEMATODES OF PEANUTS AND SOYBEANS

BACKMAN P A; RODRIGUEZ-KABANA R; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: ALA00614 Project Type: HATCH
Agency ID: CSRS Period: 05 OCT 83 to 30 SEP 89

Objectives: Assess damage and economic loss to peanuts and soybeans caused by nematode and fungal pathogens. Evaluate systems for control of important pathogens within a framework of sound production economics.

Approach: The economic importance of diseases and nematodes of peanuts and soybeans will be evaluated on an individual basis by adjusting pest levels with pesticide and subsequently determining host response. Later studies will evaluate multiple pest systems for their combined effects on the host. Chemical, biological, and cultural control systems will be evaluated for control efficiency relative to each other, and for economic return in an overall management system. These management systems will be developed with extensive utilization of losses, stress loading,

epidemiology, disease progress, and population dynamics.

Progress: 87/01 to 87/12. The efficacy of 'Deltapine 90' cotton in rotation with 'Florunner' peanut for the management of Meliodogyne arenaria was studied for 2 years. In 1985, M. arenaria juvenile populations were 98% lower in plots with cotton than peanut plots. Peanut and cotton yields were increased by treatment with aldicarb (3.3 kg a.i./ha in a 20-cm-band) in 1985 but not in 1986. In 1986, peanut yields were highest and M. arenaria juvenile populations were lowest in plots planted to cotton in 1985. In 1986, numbers of M. arenaria juveniles in plots with peanut both years were reduced by treatment with aldicarb to levels found in plots with cotton-peanut rotation. Cotton-peanut rotations resulted in management of M. arenaria and increased peanut yields without the use of nematicides. Studies on biological control utilizing chitin-based soil amendments demonstrated that several formulations provided effective control of M. arenaria in the greenhouse, microplots, and field experiments on several types of crops. Studies on the biological control of foliage pathogens revealed that antagonists applied to leaf surfaces alone did not suppress pathogens, while either a selective foodbase added in conjunction with the antagonist, or the foodbase added to leaf surfaces without the antagonist suppressed Cercospora leafspot of peanuts. The foodbase was shown to sustain growth of added antagonists, for up to 3 weeks.

Publications: 87/01 to 87/12

PEDERSEN, J.F. and RODRIGUEZ-KABANA, R. 1987. Nematode response to cool season annual graminaceous species and cultivars. Annals of Applied Nematology 1:116-118.

RODRIGUEZ-KABANA, R., MORGAN-JONES, G. and CHET, I. 1987. Biological Control of Nematodes: Soil Amendments and Microbial Antagonists. Plant and Soil 100:237-247.

RODRIGUEZ-KABANA, R., IVEY, H. and BACKMAN, P.A. 1987. Peanut-cotton retations for the management of Meloidogyne arenaria. Journal of Nematology 19(4):484-486.

RODRIGUEZ-KABANA, R., ROBERTSON, D.G. and KING, P.S. 1987. Comparison of methyl bromide and other nematicides for control of nematodes in peanut. Annals of Applied Nematology 1:56-58.

RODRIGUEZ-KABANA, R., WEAVER, D.B. and KING, P.S. 1987. Soybean response to a planting-time application of ethylene dibromide in a soil infested with Meloidogyne incognita, M. arenaria, and Heterodera glycines.

WEAVER, D.B., RODRIGUEZ-KABANA, R. and CARDEN, E.L. 1987. Soybean response to ethylene dibromide in a soil infested with Meloidogyne arenaria and Heterodera glycines. Annals of Applied Nematology 1:94-96.

BACKMAN, P.A. 1987. Control of peanut soilborne diseases may afford yield breakthrough. Ala. Agric. Exp. Stn. Highlights Agr. Res. 34(4):.

23.005 CRIS0096818

TAXONOMY AND ECOLOGY OF MYCOFLORAS IN ALABAMA AGRICULTURAL SOILS

MORGAN-JONES G; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36830.

Proj. No.: ALA-05-0066 Project Type: STATE
Agency ID: SAES Period: 01 OCT 85 to 30 SEP 90

Objectives: Identify fungal species and characterize their relationships to microhabitats in soil. Define the physiological and ecological factors controlling fungal growth in soil.

Approach: A number of specialized ecological niches and microhabitats such as nematode cysts, body cavities of soil microarthropods, root surfaces and organic particles will be examined for the presence of fungi. Nematode cysts and microfauna will be extracted from soil by flotation and Baermann funnel techniques respectively. Taxonomic studies on isolated fungi will be conducted where warranted and determination made of factors affecting their growth in soil and their capacity to degrade various substrates and to parasitize other microorganisms.

Progress: 87/01 to 87/12. Research has continued on the potential of opportunistic soil-borne fungi, belonging to the genera Gliocladium, Myrothecium, Ulocladium and Verticillium, for biological control of phytonematodes in Alabama agricultural soils. The effectiveness and mode of action of certain organic amendments to soil for management of nematode population dynamics have been investigated further, with particular attention being paid to stimulation of antagonistic mycofloras. Organic matter can be modified by addition of specific compounds to selectively enhance populations of certain fungi in soil or can be inoculated with particular species prior to introduction. In each case some success has been achieved in designing amendments that will induce suppressiveness. Attention has been paid to factors, including fungistasis and competitive ability, that regulate effective establishment of introduced species. Some fungi, such as Gliocladium roseum,have been found to establish readily while others, such as Verticillium chlamydosporium, do not compete as effectively in most soil agroecosystems. Further research on fungal endophytes of pasture grasses has been conducted and a number of new taxa recognized and described. These include Acremonium chisosum, A. huerfanum and A. starrii. A new, comprehensive description of the Acremonium anamorph (A. typhinum) of Epichloe typhina, the causal organism of choke disease of grasses, was published.

Publications: 87/01 to 87/12

MORGAN-JONES, G. and RODRIGUEZ-KABANA, R. 1987. Fungal biocontrol for the management of nematodes. Chapter 14 in Vistas on Nematology, Society of Nematologists: pp. 94-99.

RODRIGUEZ-KABANA, R., MORGAN-JONES, G. and CHET, I. 1987. Biological control of nematodes: soil amendments and microbial antagonists. Plant and Soil 100:237-247.

CARRIS, L.M., GLAWE, D.A. and MORGAN-JONES, G. 1987. Stagonospora heteroderae, a new species isolated from cysts of Heterodera glycines. Mycotaxon 29:451-455.
WHITE, J.F. and MORGAN-JONES, G. 1987. Endophyte-host associations in forage grasses. VII. Acremonium chisosum, a new species isolated from Stipa eminens in Texas. Mycotaxon 28:178-189.
WHITE, J.F. and MORGAN-JONES, G. 1987. Endophyte-host associations in forage grasses. IX. Concerning Acremonioum typhinum, the anamorph of Epichloe typhina. Mycotaxon 29:489-500.
MDRGAN-JONES, G. and BURCH, K.B. 1987. Studies in the genus Phoma. VIII. Concerning Phoma medicaginis var. medicaginis. Mycotaxon 29:477-487.
MORGAN-JONES, G. and BURCH, K.B. 1987. Studies in the genus Phoma. IX. Concerning Phoma jolyana. Mycotaxon 30:239-246.

23.006 CRISO131899
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

RODRIGUEZ-KABANA R; Plant Pathology; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: ALA00711 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation. To develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: The general orientation of the research will involve the study of selected rotation systems for their effects on nematode population dynamics and on their antagonists.

Progress: 87/01 to 87/12. Studies on the effect of crop rotation systems on population dynamics of Meliodogyne arenaria were started at Headland, Alabama. Similar on-going studies were continued. The relation between soil depth and population development of M. arenaria juveniles was studied for a 15-month period beginning in January 1986 in a peanut field at the Wiregrass Substation, Headland, Alabama. The soil was sandy loam with <1.0% (w/w) organic matter and had been in peanut culture for the preceeding 10 years. Juvenile numbers in soil were highest in the top 30-40 cm of the soil profile. A fairly constant but low (<20 juveniles/100 cm soil) population of juveniles was observed throughout the study at depths below 40 cm. The relationship between numbers of juveniles (J) and soil depth in cm (X) conformed to the equation: J=A B /X/) XC, where A, B, and C are constants and X>0. The equation predicted largest numbers of juveniles at ca. 12 cm depth. The greatest fluctuations in juvenile population size occurred in the top 30-40 cm of the profile. Juvenile populations were highest just prior to peanut harvest and lowest in the late-winter-spring period.

Publications: 87/01 to 87/12
RDDRIGUEZ-KABANA, R., WEAVER, C.F., ROBERTSON, D.G. and SNDDDY, E.L. 1986. Population dynamics of Meloidogyne arenaria juveniles in a field with Florunner peanut. Nematropica 16:185-196.
RDDRIGUEZ-KAMANA, R. and ROBERTSON, D.G. 1987. Vertical distribution of Meloidogyne arenaria juvenile populations in a peanut field. Nematropica 17:(IN PRESS).
RODRIGUEZ-KABANA, R., IVEY, H. and BACKMAN, P.A. 1987. Peanut-cotton rotations for the management of Meloidogyne arenaria. Journal of Nematology 9:484-486.
RODGRIGUEZ-KABANA, R., MORGAN-JONES, G. and CHET, I. 1987. Biological control of nematodes: Soil amendments and microbial antagonists. Plant and Soil 100:237-247.
MORGAN-JONES, G., & RODRIGUEZ-KABANA, R. 1987. Fungal biocontrol for the management of nematodes. Pp. 94-99 in J.A. Veech and D.W. Dickson, eds. Vistas on Nematology. Society of Nematologists.

23.007 CRISO009273
INFLUENCE OF CULTURAL & MANAGEMENT PRACTICES ON GROWTH & YIELD OF SOYBEANS

CAVINESS C E; Agronomy; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK00591 Project Type: STATE
Agency ID: SAES Period: 23 AUG 62 to 31 DEC 87

Objectives: Evaluate effects of rates and dates of planting, row widths, and plant populatins on productivity of new cultivars. Determine effects of stand reduction, leaf removal, and plat cutoff of plant development and seed yield. Determine rate of root growth and root distribution of genotypes when grown underr different management systems.

Approach: Research will be conducted on major soil types and in different climatic regionsof the state using appropriate experimental designs and field plot techniques. Information on seed and forage yield, seed quality, plant height and lodging, disease and isect damage, etc., will be obtained when it appears these data will be of value in determining effectiveness of particular cultural and management treatments. Most of the research will be conducted at Branch Experiment Stations but some of the research, particulrarly that on rooting patterns, will be conducted in field plots, greenhouses, and growth chambers at the Main Experiment Station.

Progress: 87/01 to 87/12. Research was conducted to study the effect of blends of cultivars with different types of resistance to soybean cyst nematode (SCN) on yield and SCN populations. All combinations of 2-cultivar blends were made with Dare (susceptible), Forrest (resistant to races 1 and 3), and Epps (resistant to races 3 and 4). None of the blends produced higher yields or reduced the SCN populations more than Epps, but blends of resistant and susceptible cultivars were equal to Epps in yield and SCN population densities. Results indicate that blends may be used to reduce the risk of selecting more virulent

races of SCN and maintain high yield levels. Studies were conducted to determine the influence of scion and rootstock on selected growth characteristics and nodulation. The scion showed significant genetic control of plant height, number of nodes, days to maturity, and seed size. Seed yield and stem diameter were primarily controlled by the scion but the rootstock had some influence on these traits. The rootstock controlled the nodulating trait. The nodulating genotype, D68-0099 when used as the rootstock, failed to form nodules when scions from nodulating genotypes were grafted onto it. The rootstock significantly affected the number of nodules formed on the taproot on the genotypes that produced nodules. Blends of determinate and indeterminate strains of the same maturity were evaluated. The determinate strains generally produced higher yields with less lodging than the indeterminate types.

Publications: 87/01 to 87/12

GOLDMON, D.L. and CAVINESS, C.E. 1987. The influence of scion and rootstock on growth characteristics and nodulation of soybeans. Abstr. Southern Assoc. of Agri. Scientists Annual Meeting, Nashville, TN, p. 2.

GOLDMON, D.L. 1987. Influence of scion and rootstock on growth characteristics and nodulation of soybean. M.S. Thesis, University of Arkansas, Fayetteville. 65 pp.

23.008 CRIS0080498

DEVELOPMENT OF SOYBEAN GERMPLASM FOR CONTROL OF SOYBEAN-CYST NEMATODE

WIDICK J D; RIGGS R D; Agronomy; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK01010 Project Type: STATE
Agency ID: SAES Period: 01 OCT 85 to 30 SEP 90

Objectives: To identify new sources of resistance to soybean cyst nematode populations occurring in Arkansas. To incorporate new sources and combinations of nematode resistance into agronomically desirable soybean genotypes, especially those adapted to narrow row culture. To evaluate resistant genotypes for long term effects on SCN population dynamics when used in crop rotations and narrow row culture.

Approach: In cooperation with Department of Agronomy personnel, work will be conducted at the ASU station to develop superior yielding cultivars of soybeans having new sources and combinations of resistance to soybean cyst nematode. Emphasis will be placed on development of resistant genotypes adapted to narrow row culture. Crop rotation sequences involving various sources of resistance and their effects on nematode populations will be evaluated.

Progress: 87/01 to 87/12. A study was initiated to determine the effect of close row spacings of soybean (Glycine max L. Merr.) on various soybean-cyst nematode populations developed on soybean genotypes differing in the source of resistance each possessed. Nematode populations were developed on soybean row spacings of 91 cm. Row spacings of 91 and 45 cm. were used in 1987 to compare population levels after one year of reproduction on the two spacings. Soybean yields were higher from 91 cm. row spacings. Yields were highest from plots in which populations had developed on a sequence of soybean genotypes used in a rotation of susceptable, resistance from Peking and resistance from Peking and PI 88788. A study to determine the long-term effect of lower-than-recommended levels of P and K for soybean production on cyst nematode population levels as well as on shifts in reproductive abilities of the populations on soybean differentials was continued from previous years. Soybean yields were low because of drought. Yields of plots which received applications of P and K fertilizer in accordance with soil test laboratory recommendations were not significantly higher than those which received no fertilizer. Approximately 2000 new soybean lines were screened for reaction to races 3, 4 and "Bedford" race of soybean-cyst nematode. Twenty percent (20%) of these lines were found to be resistant to one or more of the races of nematode. These lines were tested at four locations to determine yield and agronomic characteristics.

Publications: 87/01 to 87/12

GIPSON, R.D. and WIDICK, J.D. 1987. Effects of cropping sequences on cyst nematode populations. Abst. Southern Div. Amer. Soc. of Agron. Annual meeting, Feb. 1-4, Nashville, TN.

WIDICK, J.S. and GIPSON, R.D. 1987. Soybean cyst nematode population shifts at two soil fertility levels. Abst. Southern Div. Amer. Soc. of Agron. Annual meeting, Feb. 1-4, Nashville, TN.

23.009 CRIS0076944

CONTROL TECHNOLOGY FOR DISEASES, NEMATODES AND INSECTS OF SOYBEANS

RIGGS R D; ROBBINS R T; RUPE J C; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK00941 Project Type: STATE
Agency ID: SAES Period: 30 MAY 85 to 30 SEP 89

Objectives: Define sudden death syndrome (SDS) and establish control measures for soybean diseases. Determine damage thresholds and measures of control for insects and nematodes. Establish interactions among nematodes, weeds and insects.

Approach: Monitor soybean fields for diseases, insects and nematodes. Collect environmental data and use appropriate biological techniques to define SDS. Use appropriate experimental designs for field and micro plots to determine or refine damage and interactions for diseases, nematodes and insects. Establish appropriate control practices, including the evaluation of pesticides and chemigation.

Progress: 87/01 to 87/12. A causal agent was isolated from sudden death syndrome (SDS) affected soybean. Fusarium solani (BFS) was

isolated from all infested fields studied. It is a root-rot type organism. Cultivar tests indicated none were immune; some were only mildly affected. SDS severity was directly related tosoil level of BFS. A cultivar with low susceptibility was penetrated as often as those highly susceptible. Fungicides reduced anthracnose stem lesions. Studies with isolates of Macrophomina phaseolina from different crops showed variation in pathogenicity and indicated rotations would be an effective control. A new nematicide candidate did not improve soybean yields on cyst nematode(SCN) infested soil. It reduced nematode penetration in greenhouse tests. Failure to control hemp sesbania in rice can result in high SCN popluations. SCN became dormant at the same time on Group IV and VIII soybean cultivars. Interactions of SCN and threecornered alfalfa hopper (TCAH) were studied using different levels of each. Six species of plant parasitic nematodes were tested for pathogenicity to soybean. Four population levels of TCAH did not reduce soybean yields. Fourth instars of TCAH were more injurious that 3rd or 5th instars. First and 2nd instars of tarnished plant bug did not survive on soybean but 3rd instars matured. Extended subeconomic level defoliation did not reduce soybean yields. Drop cloth and sweep net efficiency varied with insect stage and soybean height. Lloyd is highly resistant to stem canker.

Publications: 87/01 to 87/12

ROBBINS, R.T. 1987. Microplot study on soybean cyst nematode race 3 damage to susceptible soybean. Journal of Nematology 19:552.

23.010* CRIS0057873

NATURE AND EXTENT OF VARIATION IN ROOT-KNOT AND CYST NEMATODES

RIGGS R D; ROBBINS R T; SLACK D A; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.

Proj. No.: ARK00731 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 70 to 30 SEP 87

Objectives: Characterization of the variability in root-knot and cyst nematodes; determination of the abiotic and biotic factors that modify population dynamics of root-knot and cyst nematodes.

Approach: Two populations each of M. incognita will be grown on three hosts at 4 temperatures. At intervals populations will be tested differentials to test for changes in parasitic capabilities. Meloidogyne incognita and Heterodera glycines will be cultured on various hosts with soil additives. Again, the populations will be tested at intervals to check for changes in parasitic capabilities. Races 3 and 4 of H. glycines will be cultured on good hosts, treated with "contact" nematicides then planted to resistant varieties. Various rates of nematicide will be tested as well as repeated treatments. A series of cultivars of soybeans including resistant resistant and susceptible cultivars will be inoculated with H. glycines or M. incognita or both. After time for one, two or three generations the progeny will be tested on a preselected group of differentials to determine what the parasitic capabilities are and if there have been any changes. Matings between H. glycines and closely related species will be made and the progeny will be checked for changes in parasitic capabilities.

Progress: 87/01 to 87/12. Test of 80 soybean cyst nematode (SCN) populations from several states and three other countries revealed representatives of races 1, 2, 3, 4 and 5 plus six other races which have not been described. Several populations reproduced on Bedford soybean, not a differential. These were from fields where Bedford had been grown 1-3 years. Uniform race tests using differentials from Arkansas, Illinois and North Carolina revealed that the PI 88788 line used in Arkansas was not really PI 88788. This emphasized the importance of uniform differentials from a single source. Isozyme analyses from several cyst species and SCN races indicated that they can be used to separate species but not races. Mitochondrial DNA analyses showed promise for separating SCN races. Ultrastructure studies on Forrest and Bedford soybeans revealed two types of resistance based on the reaction of the tissue to nematode invasion. Single egg mass populations of a Meloidogyne sp. from a soybean field showed considerable variability in host differential response.

Publications: 87/01 to 87/12

SHILLING, K. 1981. Life cycle studies of variants of the soybean cyst nematode, Heterodera glycines. M.S. Thesis. University of Arkansas, Fayetteville.

RIGGS, R.D., HAMBLEN, M.L. and RAKES, L. 1981. Infra-species variation in reaction to hosts in Heterodera glycines populations. J. Nematol. 12:171-179.

RIGGS, R.D., RAKES, L. and HAMBLEN, M.L. 1982. Morphometric and serologic comparisons of a number of populations of cyst nematode. J. Nematol. 14:188-199.

RIGGS, R.D. (Ed.) 1982. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.

RIGGS, R.D. 1982. Cyst nematodes in the Southern region. Pp. 77-95. In R.D. Riggs, ed. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.

SLACK, D.A. and RIGGS, R.D. 1982. The bud and leaf nematodes. Pp. 180-182. In R.D. Riggs, ed. Nematology in the Southern region of the United States. Southern Coop. Series Bull. 276.

KIM, Y.H., KIM, K.S. and RIGGS, R.D. 1984. Structural changes associated with resistance of soybean to Heterodera glycines. Proc. 1st Internat. Cong. Nematol. p. 43. (Abstr.).

23.011 CRIS0131671
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEANS

RIGGS R D; ROBBINS R T; SLACK D A; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK01282 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation; and to develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne spp. and Heterodera glycines.

Approach: Plots will be managed to induce change from race 2, 4 or 5 of H. glycines to race 1 or 3. Differences in virulence of races 1-5 will be checked in the greenhouse. Fungi isolated from cysts will be characterized to see how they might be used in biocontrol.

Progress: 87/01 to 87/12. Analysis of 20 isozymes from 12 populations of Heterodera glycines (SCN) revealed that only 5 of the isozymes were useful in detecting variability in SCN, none for separating races. Mitochondrial DNA from the 12 populations was examined by restriction endonuclease digestion. A wild type was found and low variability indicated SCN in North America was of recent introduction. Comparisons of DNA from SCN and H. schachtii indicated the two species are related but separated millions of years ago. The purpose of this research was to find a more accurate method for separation of SCN races. Several inbred populations and single cyst selections of SCN race 3 are ready for race testing to check purity. The purest type will be used as a standard for race test comparisons. After 2 years of fumigation and planting of susceptible cultivars on soil infested with SCN "Bedford race", the level of reproduction on Bedford was not diminished. This is an attempt to shif the population back to a race to which we have resistance. In SCN tolerance tests DPL 566 yielded as much on infested as on non-infested soil. A6785, A7986, Bragg and Lloyd all yielded more on infested than non-infested soil but only Lloyd yielded as much as DPL 566. A fungus isolated from a soybean field was effective in reducing SCN populations in pots in the greenhouse. This will be tested in the field as a biocontrol agent.

Publications: 87/01 to 87/12
RIGGS, R.D. and SCHMITT, D.P. 1987. Nematodes. Pp. 757-778 in J.R. Wilcox, ed. Soybeans: Improvement, production and uses. Madison, WI: Society of Agronomy.
KIM, Y.H., RIGGS, R.D. and KIM, K.S. 1987. Structural changes associated with resistance in soybean to Heterodera glycines. Journal of Nematology 19:177-187.
RIGGS, R.D. 1987. Nonhost root penetration by soybean cyst nematode. Journal of Nematology 19:251-254.
SCHMITT, D.P. and RIGGS, R.D. 1987. Hatch response of Heterodera glycines eggs to host and nonhost plant species. Journal of Nematology 19:557 (Abstr.).
ROBBINS, R.T. 1987. Observed race changes of Heterodera glycines in successive plantings of SCN resistant and susceptible soybeans in Arkansas. Journal of Nematology 19:552.

23.012 CRIS0085861
PHYTOPARASITIC NEMATODES: DAMAGE THRESHOLDS, DISTRIBUTION AND IDENTIFICATION ON IMPORTANT CROPS

ROBBINS R T; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK01096 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Determine damage thresholds for soybean cyst nematode and other phytoparasitic nematodes on crops in Arkansas. Develop a modeling system to predict nematode damage. Determine effects of crop rotation, fumigation and crop resistance on population dynamics of phytoparasitic nematodes. Conduct nematode surveys on soybean, wheat and cotton. Provide basic information on nematode species, thresholds, distribution, and identity needed to make timely advisories to growers.

Approach: Microplots, fumigation of field plots, and crop rotations will be used to establish and define damage threshold data. In microplots the effects of selected variables will be investigated. Nematodes will be identified to species. Species, host and location will be recorded for host and distribution records. Experiments will be designed for statistical analysis.

Progress: 87/01 to 87/12. During 1987 personnel in the Arkansas Nematode and Diagnostic Laboratory identified and counted the nematodes in over 1700 nematode samples in excess of research samples. About 150 of the samples were for growers on a fee basis; just over 100 were from demonstrations for state and county extension personnel, verification programs, and disease diagnoses; about 25 for the state plant board; over 750 as a co-operating researcher; and over 650 in assays of soybean, wheat and cotton in conjunction with the USDA National Agricultural Statistics Service. In the assays of wheat, cotton and soybean 16, 19, and 18 species of phytoparasitic nematodes were found, respectively. At least one species of phytoparasitic nematode was found in 77.5%, 85.4% and 82.9% of the wheat, cotton and soybean samples respectively. Soybean cyst nematode was found in 40.8%, 21.4% and 64.4% of the wheat, cotton and soybean samples, respectively. Meliodogyne species (Root Knot) was found in 1.4%, 14.6% and 0.8% of the wheat, cotton and soybean samples, respectively. Measurement on over 70 populations of Longidorus spp. from North America have been completed, drawings, photography, and descriptions are underway. A new species of Trophrous is currently being described.

Publications: 87/01 to 87/12
ROBBINS, R.T., RIGGS, R.D. and VONSTEEN, D. 1987. Results of Annual Phytoparasitic Nematode Surveys of Arkansas Soybean Fields

1978-1986. Annals of Applied Nematology 1:50-55.
WEST, C.P., IZEKAR, E., OOSTERHUIS, D.M. and ROBBINS, R.T. 1987. Associations of endophytic fungus with drought tolerance and nematode resistance in tall fescue. Arkansas Farm Research 36(6):3.

23.013 0139940
CONTROL OF SOYBEAN STUNT DISEASE THROUGH THE USE OF CROP ROTATION AND RESISTANT SOYBEAN VARIETIES

EVANS T A; CARROLL R B; Plant Science; University of Delaware, Newark, **DELAWARE** 19717.
Proj. No.: DEL07113 Project Type: STATE
Agency ID: SAES Period: 01 JUN 89 to 31 MAY 90

Objectives: 1. Evaluation of crop rotation schemes utilizng resistant and susceptible soybean varieties, corn, grain sorghum, and small grain to manage soybean severe stunt disease (SSSD). 2. Evaluation of soybean varieties for response to infection by soybean severe stunt disease. 3. Demonstrate transmission of soybean severe stunt disease by the dagger nematode in soybean.

Approach: 1. Establish 3-4 year rotation study with above crops on site infested with viruliferous dagger dematodes. Plot size 400 ft sq 4 reps and CRD. 2. Monitor dagger nematode populations pre-, mid-, and post-harvest. 3. Continue field evaluation of soybean cultivars susceptibility to SSSD compared with 'Essex' control. 4. Greenhouse and growth chamber studies with known viruliferous dagger nematodes and 'Essex' soybean to demonstrate transmission of SSSD.

23.014* CRIS0096487
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RICH J R; Agricultural Research Center, Live Oak, **FLORIDA** 32060.
Proj. No.: FLA-LIO-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 86/10 to 87/09. Twenty-eight accessions of pigeonpea were obtained from various parts of the world including India, Puerto Rico, Honduras, and Haiti. Greenhouse tests were initiated to determine relative resistance or tolerance of these accessions to Meliodogyne javanica and M. incognita. Individual plants in 150 cc containers were inoculated with 1500 eggs each of M. javanica or M. incognita. Sixty-five days after inoculation, number of egg masses, and root galling was determined. Of the accesions inoculated with M. javanica, 11 of the 28 exhibited no egg mass production or root galling. Twenty-five accessions of the 28 accessions inoculated with M. incognita exhibited no galling or egg mass production. Test data indicated a range of responses from susceptibility to immunity in pigeonpea to the two nematode species. Further tests under field conditions are necessary to confirm these observations.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

23.015 CRIS0141502
ENHANCEMENT OF PEST RESISTANCE AND ADAPTATION OF SOYBEANS FOR SOUTHEASTERN U.S.

HINSON K; Agricultural Research Service, Gainesville, **FLORIDA** 32601.
Proj. No.: 6615-22000-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 31 MAR 91

Objectives: Provide improved germplasm and efficient breeding procedures for extending the optimum soybean planting period in Southeastern U.S.; reducing losses from nematodes, insects and diseases; and improving product quality.

Approach: Develop genotypes adapted to broader ranges of planting and harvest periodsand describe the genetic and physiological basis for such adaptation; develop high yielding genotypes with improved combinations of nematode- resistant factors and incorporate resistance to insects and diseases; document improvements in yield, quality, or production efficiency associated with resistance; and determine the inheritance of specific traits.

Progress: 87/01 to 87/12. Seed of breeding line F83-1415 was increased for its release as a cultivar for South Texas. It has a recently-identified long juvenile trait which, under short-day conditions, adapts soybean genotypes to broader ranges of planting dates and latitudes. It will be the first cultivar with this novel characteristic. Breeding lines resistant to four root-knot and cyst nematode pests important in Southeastern U.S. demonstrated cultivar potential in regional tests. No currently available cultivar is resistant to all four pests. These lines will be valuable parents and when released will reduce production hazards from nematodes. Soybean germplasm adapted to Southeastern U.S. was further enhanced by the selection of high yielding breeding lines which combine a high level of resistance to soybean stem canker with

resistance to two or more important nematode pests, and by the selection of lines which combine a high level of resistance to velvetbean caterpillar with good agronomic characteristics. The latter lines were crossed with nematode-resistant parents to produce high yielding genotypes resistant to both types of pests.

Publications: 87/01 to 87/12

HILL, H.J., WEST, S.H. and HINSON, K. 1986. Seed size, genotype, and permeability type effects on mass and thickness of soybean seedcoat. Amer. Soc. Agron. Abstracts, p. 127.

TINIUS, C.N. and HINSON, K. 1987. Selection in soybean for discrete levels of seedcoat permeability. Amer. Soc. Agron. Abstracts, p. 82

KINLOCH, R.A. and HINSON, KUELL. 1987. In search of: The invincible bean. University of Florida, IFAS Research 87. pp. 28,29.

23.016 CRIS0098453

MANAGING ROOT-KNOT DISEASES WITH A NONFUMIGANT NEMATICIDE AND BIOCONTROL AGENTS

DICKSON D W; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02447 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 84 to 31 DEC 85

Objectives: Using tobacco and soybean as crop model system we propose to determine, 1) the separate effects of ethoprop in combination with Paecilomyces lilacinus and Bacillus penetrans, 2) the combination effects of P. lilacinus and B. penetrans on M. javanica, 3) whether the nematicide has any adverse effect on P. lilacinus or B. penetrans, and 4) the tolerance of P. lilacinus to high field soil temperature.

Approach: Microplots and naturally infected field soil will be treated with suspensions of P. lilacinus, B. penetrans or combination of the two. Heat treated rice seeds will be added to microplots receiving P. lilacinus. Two separate experiments will be conducted. One will be carried out on the Agronomy Farm, Gainesville and the second will be conducted at the Agriculture Research Center, Live Oak.

Progress: 88/01 to 88/12. The Efficacy of the nematode parasite Paecilomyces lilacinus, alone and in combination with phenamiphos and ethoprop, for controlling the root-knot nematode Meloidogyne javanica on tobacco and the ability of this fungus to colonize in soil under field conditions were evaluated for 2 years in microplots. Combinations and individual treatments of the fungus grown on autoclaved wheat seed, M. javanica eggs (76,000 per plot), and nematicides were applied to specified microplots at the time of transplanting tobacco the first year. Vetch was planted as a winter cover crop, and the fungus and nematicides were applied again the second year to specified plots at transplanting time. The fungus did not control the nematode in either year of these experiments. The average root-gall index (0=no visible galls and 5=>100 galls per root system) ranged from 2.7 to 3.9 the first year and from 4.3 to 5.0 the second in nematode-infested plots treated with nematicides. Plants with M. javanica alone or in combination with P. lilacinus had galling indices of 5.0 both years; and the latter produced lower yields than all other treatments during both years of the study. Nevertheless, the average soil population densities of P. lilacinus remained high, ranging from 1.2 to 1.3 x 10 propagules/g soil 1 week after the initial inoculation and from 1.6 to 2.3 x 10 propagules/g soil at harvest the second year.

Publications: 88/01 to 88/12

HEWLETT, T.E., DICKSON, D.W., MITCHELL, D.J. and KANNWISCHER-MITCHELL, M.E. 1988. Evaluation of Paecilomyces lilacinus as a biocontrol agent of Meloidogyne javanica on tobacco. J. Nematology 20:578-584.

23.017* CRIS0096489

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

DICKSON D W; DUNN R A; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with field corn, peanut, soybean, and forage crops grown in Florida, and to design and evaluate management strategies to reduce economic losses on these crops.

Approach: The population dynamics and economic damage levels of Pratylenchus brachyurus and Mel Meloidogyne arenaria on peanut and P. brachyurus and Paratrichodorus sp. on corn will be established. The efficacy of fumigant and nonfumigant nematicides for management of nemas on peanut and corn will be investigated. A crop rotation management scheme will be evaluated for managing M. arenaria on peanut. The population dynamics of nemas in minimum tillage-multicropping systems will be monitored. Host-parasite relationships and economic damage relationships of Meloidogyne spp. to soybeans and of various nematodes including Belonolaimus spp. and Meloidogyne spp. to forage crops will be investigated. In cooperative efforts with plant breeders, germ plasm of forage crops, primarily legumes, will be screened for reactions to Meloidogyne spp.

Progress: 87/10 to 88/09. Three tests were conducted to evaluate the efficacy of fumigant and nonfumigant nematicides for control of Meloidogyne arenaria race 1 on peanut. Methyl bromide, 1, 3-D, methyl isothiocyanate, methyl isothiocyanate mixtures, aldicarb, ethoprop, fenamiphos, and F5145 were evaluated by different methods of application preplant, at plant or at early flowering. Of the 32 treatments evaluated, only seven resulted in yield increases (P = 0.05) although early season vigor was high in all treated plots.

During the latter one-third of the growing season, however, nematode control was not adequate in most treatments resulting in heavy peg, pod, and root infection by M. arenaria. Four populations of Pratylenchus brachyurus were tested in a greenhouse on selected plant species to determine host suitability and usefulness inidentifying physiological races of the nematode. The differential plants were alfalfa, snap bean, citrus, corn, peanut, soybean, and tomato. Fresh shoot or root weights of plants inoculated with all populations were similar to each other and to the uninoculated control in both experiments. The numbers recovered from snap bean were different (P = 0.05) between populations in each test and from soybean in the second test. The differences between populations on snap bean were different in 2 tests. The effect of two cropping and tillage systems on the population dynamics of 4 nematode species was evaluated.

Publications: 87/10 to 88/09

PAYAN, L.A. and DICKSON, D.W. 1988. Host specificity of four populations of Pratylenchus brachyurus. Ann. Appl. Nematol. 2 'in press'.

GALLAHER, R.N., DICKESON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Tillage and multiple cropping systems and population dynamics of phytoparasitic nematodes. Ann. Appl. Nematol. 2 'in press'.

DICKSON, D.W. and HEWLETT, T.E. 1987. Effect of two nonfumigant nematicides on corn grown in two adjacent fields infested with different nematodes. Ann. Appl. Nematol. 1:89-93.

DICKSON, D.W. and MCSORLEY, R. 1987. Standarization of nematicide application rates. Ann. Appl. Nematol. 1:1-5.

DICKSON, D.W. 1984. Cultural control of nematodes. Pp. 40-45. United States Department of Agriculture, Agricultural Research Service. Nematology Workshop. Oct. 15-18.

23.018* CRIS0134264

APPLICATION OF POPULATION ECOLOGY IN THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

MCSORLEY R T; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02700 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: To assess and improve the efficiency of methods for extracting nematodes from soil. To develop sampling plans for plant-parasitic nematodes in small plots. To develop damage functions for plant-parasitic nematodes on selected agricultural crops. To determine the impact of selected crops and cover crops on dynamics of plant-parasitic nematodes. To investigate the impact of predators on dynamics of nematodes and their potential for biological control. To investigate the impact of selected nonchemical nematode management techniques, such as solarization, use of resistant or tolerant cultivars, and the cropping systems approach.

Approach: Field plots in sites containing gradients in nematode density will be used to derive damage functions and critical point models of nematode population increase. Taylor's power law will be used in the development of sampling plans.

Progress: 88/06 to 88/10. Work on this project has been initiated within the past several months. Data collected during the 1988 growing season is being used to develop damage functions for the sting nematode, Belonolaimus longicaudatus, on corn and soybean. On each crop, relationships between initial and final populations are being developed for B. longicaudatus, Meloidogyne incognita, Pratylenchus branchyurus, and Criconemella spp. Additional field data collected during 1988 are being used to develop sampling plans for these nematodes in small plots. Plant damage functions and nematode population growth functions have been derived for P. brachyurus on peanut in Queenland, Australia, and integrated into a simple management model for testing during the current growing season.

Publications: 88/06 to 88/10

MCSORLEY, R. and O'BRIEN, P.C. 1988. Application of modelling techniques for integrating management options on peanuts. Australian Nematologists' Newsletter 7(2):15-17.

23.019* CRIS0092658

BIOLOGICAL CONTROL OF PLANT PARASITIC NEMATODES AND OF INSECTS BY ENTOMOGENOUS NEMATODES

SMART G C JR; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02433 Project Type: STATE
Agency ID: SAES Period: 06 MAR 84 to 31 DEC 88

Objectives: To evaluate organisms such as fungi, bacteria and antagonistic plants as biological control agents of plant parasitic nematodes. To evaluate entomogenous nematodes as biological control agents of noxious insects.

Approach: The fungus, Paecilomyces lilacinus, will be used in experiments to control the root-knot nematode, Meloidogyne incognita. The fungus will be used alone and in conjunction with the bacterial spore parasite, Bacillus penetrans. B. penetrans also will be used alone. Other fungi and other nematodes may be used in future experiments. Antagonistic plants to be used are the digitgrasses, Pangola digitgrass initially against M. incognita and Transvala digitgrass against the sting nematode, Belonolaimus longicaudatus. Initial research will be with Neoaplectana carpocapsae against the mole crickets Scapteriscus acletus and S. vicinus.

Progress: 87/10 to 88/09. For more than three years after release of a Neoaplectana sp. (formerly called N. carpocapsae = Steinernema) from Uruguay in three small (50 m2) plots, the nematode is still causing about a 10% infection of mole crickets. The nematode has spread from

the release sites (at least 5 miles after three years), and mole cricket populations, as measured by capture of nymphs in pitfall traps, has gone from an average of 93 lymphs before treatment to 16 one year later to 6 after two years and to 4 after three years. Damage to the grass has decreased. When placed on the soil surface or just under it, the infective-stage juveniles moved downward 10 cm, infected and killed mole crickets in dishes below. They moved downward as readily outdoors in field soil as in containers of soil in the laboratory, and in fact, killed mole crickets more efficiently in the field with a concentration of nematodes 5 times less than in the laboratory. When placed in the center of a soil column, the nematodes moved both upward and downward 8 cm with a greater number moving down than up. Infective-stage juveniles were buried in the soil in tightly sealed containers or in containers covered with 10 um Nitex cloth. In both types of containers the nematodes survived and were able to kill mole crickets after the 8 or 10 weeks of the tests. Even though the numbers that survive are reduced rapidly during the first week, numbers decline much more gradually during subsequent weeks.

Publications: 87/10 to 88/09

OLEXA, M.T. and SMART, G.C., JR. 1987. Pesticides and public employee liability. Journal of Nematology 19:549 (Abstr.).

GERBER, K., SMART, G.C. and ESSER, R.P. 1987. A comprehensive catalog of plant parasitic nematodes associated with aquatic and wetland plants. Bulletin 871 (Technical) 170 pp. Agric. Expt. Sta., IFAS, Univ. Fla., Gainesville.

NGUYEN, K.B. and SMART, G.C., JR. 1988. Mode of entry of neoaplectanid nematodes into mole crickets. Soil and Crop Science Society of Florida, Proceedings 47:250 (Abstr.).

23.020* CRIS0096490

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

OVERMAN A J; Agr Res & Ed Cntr; University of Florida, Bradenton, **FLORIDA** 33508.

Proj. No.: FLA-BRA-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: Investigation of the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops grown in Florida and evaluation of management strategies designed to reduce economic losses due to nematodes attacking agronomic crops.

Approach: In minimum tilled or tilled field plots, nematode populations will be evaluated on various crop sequencing tests. Nematicides and soil-fumigants will be used to determine effect of nematodes and/or soil-borne diseases on crop production potential.

Progress: 87/10 to 88/09. A RCB design of 52 6m x 9.9 m-plots were established in a 10 year Bahia grass pasture in December 1987. Factors tested in the split plot design over a period of 3 years will be fertilizer (336 kg ha-), nematicide carbofuran (2.24 kgai ha-) and seeding of white clover (4.5 kg/ha) cvs. Osceola + Las-1 in all combinations with controls. All treatments were established in December. Furadan was applied only once. Nematode population estimates made during 12 months following treatment indicate that Hemicycliophora is the most abundant genus in the soil followed by Dolichodorus. In general, no striking nematode differences have occurred due to use of carbofuran.

Publications: 87/10 to 88/09

MISLEVY, P., et al. 1988. 'Florona' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

MISLEVY, P., et al. 1988. 'Florico' Stargrass. Fla. Agr. Exp. Sta. Circ. (In Press).

23.021* CRIS0096488

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

KINLOCH R A; Agr Res Cntr; University of Florida, Jay, **FLORIDA** 32565.

Proj. No.: FLA-JAY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 88/01 to 88/12. Winter planting of Cahaba White vetch, Vantage Purple vetch, ryegrass, and wheat were not significantly different from winter fallow in their effects on the soil infestation levels of the rootknot nematode Meloidogyne incognita and on subsequent galling and yields of rootknot susceptible (Hartz 7126) and resistant (Hartz 7110) soybean cultivars. Galling and yield of the susceptible cv over all winter treatments were 2.7 (on a scale of 0-4) and 1228 kg/ha; whereas those of the resistant cv weere 0.1 and 2269 kg/ha. Field studies were initiated to study the influence of summer planted crops (soybean, sorghum, maize, alyceclover, millet, sorghum X sundangrass, lespedeza, hairy indigo, peanut, aeschynomene, and cotton) on the abundance of Meloidogyne arenaria. In evaluations of 34 public and commercial cultivars and breeding lines at a site infested with M. arenaria, yields ranged from 111 kg/ha (DP 497, galling = 3.8 on a scale of 0-4) to 1591 kg/ha (Asgrow 6785, galling = 1.8). Yield

of all cultivars (Y) was related to galling (X) by Y = 2084-475X, r = -0.77 (P < 0.01). At a site infested with M. incognita yields ranged from 999 kg/ha (S69-96, galling = 2.6) to 2941 kg/ha (Coker 6847, galling = 0.3). Yield was related to galling as Y = 2691-430X, r = -0.65. At a site infested with the soybean cyst nematode Heterodera glycines (Race 3) yields ranged from 1221 kg/ha (Cobb) to 2793 kg/ha (Coker 6847).

Publications: 88/01 to 88/12

KINLOCH, R.A. 1988. Incidence of nematode trophic groups in a native woodland soil and in adjacent agricultural soil planted to various crops. Proc. Soil Crop Sci. Soc. Florida 47: 249-250.

KINLOCH, R.A. and RODRIQUEZ-KABANA, R. 1989. Rootknot nematode disease. In Compendium of soybean diseases. American Phytopathological Society. (In press).

23.022* CRIS0131246

BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

KINLOCH R A; Agri Res & Education Center; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02624 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: The seasonal population dynamics of root-knot nematodes will be monitored in replicated field plots planted to soybean, sorghum, cotton, and maize. Post-harvest samples of nematodes from the different crops will be examined morphologically to determine distribution changes among the populations.

Progress: 87/10 to 88/09. The relative pathogencities of populations of Meloidogyne incognita and M. arenaria were compared to six soybean cultivars in tests conducted in replicated (X6) field plots and in greenhouse experiments using a pruned soybean technique (single cotyledon). Pruned soybean plants were separately inoculated with 868+-60 incognita juveniles and 1027+-48 arenaria juveniles. After approximately 1 month, three levels of susceptibility were recognized among the cultivars inoculated with incognita: Pioneer 9751, Centennial, and Gordon were the least susceptible, averaging 12 galls per g root. Bedford and Braxton averaged 49 galls, and S69-96 had 75 galls. In the field only S69-96 (gall rating of 2.6) could be separated from the other cultivars which had an average gall rating of 0.6. No levels of susceptibility and could be identified among the cultivars exposed to arenaria in the greenhouse (experimental mean of 190 galls per g root). In the field, however, Gordon (1.3) and Braxton (1.8) were significantly less galled than Bedford (2.4) and Pioneer 9751 (2.5). The most susceptible were Centennial (3.0) and S69-96 with a gall rating of 3.4.

Publications: 87/10 to 88/09

NO PUBLICATIONS REPORTED THIS PERIOD.

23.023* CRIS0096486

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RHOADES H L; Central Fla Res & Ed Center; University of Florida, Sandford, **FLORIDA** 32771.
Proj. No.: FLA-SAN-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of plant nematodes associated with certain agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicides in field studies and evaluate according to yield phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 85/10 to 86/10. The sting nematode, Belonolaimus longicaudatus, and the lance nematode, Hoplolaimus galeatus, were placed alone and in combination on field corn, Zea mays. Both nematodes increased to high populations when alone, but in concomitant populations, the sting nematode reproduced rapidly and built up to a population essentially the same as when alone, whereas the lance nematode increased to only approximately 50% of its population when alone. Injury to the corn was much more severe from the sting nematode. Populations of the sting nematode were high following summer cover crops of sorghum-sudangrass (Sorghum bicolor X S. sudanense), cowpea (Vigna sinensis), and a natural growth of weeds, but were low following cover crops of hairy indigo (Indigofera hirsuta) and jointvetch (Aeschynomeme americana) and soil fallow.

Publications: 85/10 to 86/10

NO PUBLICATIONS REPORTED THIS PERIOD.

23.024 CRIS0087447

SOYBEAN BREEDING

KINLOCH R A; PEACOCK H A; Plant Pathology; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02108 Project Type: STATE
Agency ID: SAES Period: 01 MAY 82 to 31 DEC 86

Objectives: The development of soybean cultivars with broad spectrum resistance to Meloidogyne incognita, M. arenaria and heterodera glycines.

Approach: Field and greenhouse evaluation of breeding lines and germplasm material for resistance to root-knot and cyst nematodes. Replicate field trials of current breeding line material that have adequate resistance to these nematodes for the selection of lines with the most desirable combination of disease resistance and agronomic characteristics.

Progress: 82/05 to 87/12. Screening for resistance to the rootknot nematodes, M. incognita and M. arenaria, was performed on replicated hill plots at sites naturally infested with each nematode on many soybean breeding lines during the duration of this project. Screening for resistance to the soybean cyst nematode, H. glycine (Race 3), was performed on replicated row plots at sites naturally infested with the nematode on many breeding lines and cultivars during the duration of this project. Many breeding lines were found resistant to the nematodes in question, either singly or as multiple resistance. The breeding line F77-1797 was released as "Kirby". In addition a model was produced relating yields to incidence of galls on plants or juvenile nematodes in the soil during the post harvest period.

Publications: 82/05 to 87/12

- KINLOCH, R.A., et. al. 1987. Soybean variety performance with high peanut rootknot nematode exposure, AREC, Jay, FL. 1986. In E. B. Whitty et. al. (Ed.) Florida field and forage crop variety report - 1986. Agron. Res. Rept. AY87-2. 55pp.
- KINLOCH, R.A., et. al. 1987. Soybean variety performance with high southern rootknot nematode exposure, AREC, Jay, FL. 1986. In E. B. Whitty et. al. (Ed.) Florida field and forage crop variety report - 1986. Agron. Res. Rept. AY87-2.55pp.
- PEACOCK, H.A., et. al. 1987. Soybean variety performance with high soybean cyst (Race 3) nematode exposure, AREC, Jay, FL. 1986. In E. B. Whitty et. al. (Ed.) Florida field and forage crop variety report - 1986. Agron. Res. Rept. AY87-2.
- KINLOCH, R.A. 1987. The Uniform Soybean Tests - Southern Region. E. E. Hartwig (Ed.). USDA, ARS. 129pp.
- PEACOCK, H.A., et. al. 1987. The Uniform Soybean Tests - Southern States, Southern Region - 1987. E. E. Hartwig and Carlton J. Edwards, Jr. (Ed.). USDA, ARS, SAES, Stoneville, MS. 129pp.

23.025* CRIS0142342

INTEGRATING CONSERVATION TILLAGE & PEST MANAGEMENT WITH IRRIGATED COTTON, SOYBEAN AND TRITICALE

DOWLER C C; JOHNSON A W; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 0500-21010-002-29D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 87 to 30 SEP 91

Objectives: To utilize irrigation application technology with new and improved integrated pest management systems for controlling weeds, nematodes, insects, and diseases in a multiple-cropping system of triticale-cotton-soybean grown under irrigated conservation tillage.

Approach: Multiple-cropping sequences of triticale-soybean, triticale-cotton or triticale-cotton-triticale-soybean will be studied. Experiments will integrate optimum and minimum pest management levels on the sequences grown in conservation tillage, and measure the allelopathic and residue management factors of triticale, cotton, and soybean. Soil pest population dynamics will be studied. Irrigation application technology will be utilized to apply crop production materials. Economic profitability, mathematical programming, and simulation models will be developed.

Progress: 87/10 to 87/12. Four tillage treatments (ridge-plant, no-till, row-till, deep-turn) were established on a winter crop of triticale following cotton. Yields of triticale from deep turn plots were 22% greater than yield from ridge-plant plots. Following triticale harvest, the residue was mowed tall (61 cm), mowed short (20 cm), or burned. Cotton (McNair 235) was planted in plots with the four tillage treatments. Yields from plants in deep-turn, row-till, and ridge-plant plots were 27%, 13%, and 7% greater, respectively, than yield from no-till plots. Triticale and cotton yields were affected by previous intensive cropping systems. Yield of cotton and nematode population densities were not affected by triticale residue management. Fenamiphos in combination with fluometuron or metribuzin increased injury to cotton and soybean, respectively. Irrigation application technology was successfully used to apply fertilizer, herbicide, nematicide, and insecticide.

Publications: 87/10 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

23.026* CRIS0140338

NEMATODE AND INTEGRATED PEST MANAGEMENT SYSTEMS FOR THE SOUTHEASTERN COASTAL PLAIN

JOHNSON A W; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 6602-24000-007-00D
Project Type: INHOUSE
Agency ID: ARS Period: 02 AUG 85 to 01 AUG 90

Objectives: Develop integrated pest management systems and models that are effective, energy efficient and economically suitable for managing and predicting populations of plant-parasitic nematodes in intensive vegetable and agronomic cropping systems under irrigation.

Approach: Field tests (using standard and new techniques) will be conducted to determine the effects of cultural practices, crop rotations, cover crops, resistant varieties, tillage methods, irrigation, chemicals and levels of pest management on nematodes, soil-borne fungi, insects, and weeds on intensive horticultural and agronomic crop production systems. Nematode population densities, root-gall indices,

seedling diseases, crop response, yield and quality will be recorded. The fate and efficacy of nematicides in soil and groundwater will be determined. The research will be conductedin cooperation with agricultural engineers, agronomists, horticulturists, economists, entomologists, plant pathologists, weed scientists, modelers, and research chemists.

Progress: 87/01 to 87/12. Numbers of root-knot nematode juveniles in intensive cropping systems were <5/150 cc soil in all plots of vegetable crops, except onion and cowpea, following tobacco, and lettuce following sweet corn. The nematode species were 100% Meloidogyne incognita on onion and lettuce, and 70% M. incognita and 30% M. arenaria on cowpea. Numbers of root-knot nematodes were <25/150 cc soil in plots of soybean, cotton, peanut and winter oats prior to planting spring crops. Yields of millet, a potential new crop for the Southeast, were 74% greater in nonirrigated plots treated with fenamiphos and low fertility than yields from similar irrigated treatments. Risk efficient action thresholds have been developed for lesion nematodes on corn. The GLEAMS model (Groundwater Loading Effects of Agricultural Management Systems) was modified to simulate the generation and degradation of pesticide metabolites. GLEAMS-simulated mass of fenamiphos, f. sulfoxide, and f. sulfone in the rhizosphere compared favorably with field data within the variability of observed data. Results from a field test to determine the efficacy of fenamiphos (73.1% in propylene glycol) mixed with Terpine (Unitrol 90) in a 1:1 ratio and fenamiphos (3 SC) applied at 3.3 and 6.6 kg/ha through an irrigation simulator with 0.62 cm of water indicated that lower dosages of fenamiphos and different formulations may provide adequate nematode control, optimum yield, and reduce potential for soil and groundwater pollution.

Publications: 87/01 to 87/12

BURTON, G.W., and JOHNSON, A.W. 1987. Coastal bermudagrass rotations for control of root-knot nematode. J. Nematol. 19:138-140.

JOHNSON, A.W. et al. 1987. The biologic and economic assessment of registered fumigants. USOA Series. 169 pp.

PAYAN, L.A., JOHNSON, A.W., and LITTRELL, R.H. 1987. Effects of nematicides and herbicides alone or combined on Meloidogyne incognita egg hatch and development. Annals of Applied Nematology 1:67-70.

JOHNSON, A.W. et al. 1987. Bibliography of estimated crop losses in the United States due to plant-parasitic nematodes. By: Society of Nematologists Crop Loss Assessment Committee. J. Nematol. 1:6-12.

JOHNSON, A.W. 1987. Nemagation via overhead irrigation. J. Nematol. 19:533. (Abstract).

JOHNSON, A.W., CSINOS, A.S., GLAZE, N.C., and GOLOEN, A.M. 1987. Cochemigation for multiple pest control on tobacco. J. Nematol. 19:533. (Abstract).

JOHNSON, A.W. et al. 1987. Nematicides - A Historical Review. IN J.A. Veech & O.W. Dickson (Eds.) Vistas on Nematology: A Commemoration of the 25th Anniv. of the Soc. of Nematol. pp. 448-454. E.O. Painter Prtg. Co., De Leon Springs, FL.

23.027* CRIS0140217

NEMATODE PATHOLOGY AND MANAGEMENT IN AGRONOMIC CROPS OF THE SOUTHEASTERN COASTAL PLAIN

MINTON N A; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.

Proj. No.: 6602-24000-006-000

Project Type: INHOUSE

Agency IO: ARS Period: 25 JUN 85 to 25 JUN 90

Objectives: To develop principles and practices of nematode control and management systems for agronomic crops that are economical, energy efficient, and environmentally safe and integrate them with other pest management practices for conventional and conservation tillage systems.

Approach: Maximize nematode control in agronomic crops using resistance rotations, multiple cropping, tillage and chemicals. Oetermine the interaction of nematodes with other pests in conservation tillage and multiple cropping and integrate with control of other pests to minimize use of chemicals and improve production. Assay soil at different levels in profile to determine rate of nematicide degredation and movement. Utilize laboratory,greenhouse, and field experiments. Obtain population densities of nematodes, fungi and insects, root damage indices, plant vigor ratings, stand counts, plant growth measurements, yield, and product quality. Collect data on peanut for developing peanut production models.

Progress: 87/01 to 87/12. In a double-crop minimum till (MT) experiment, peanut yields were the same following wheat and winter fallow. Moldboard plowed (MBP) plots produced 19% more and % sound mature kernels was greater than in plots planted by the subsoil-plant (SP) method. The nematode Meloidogyne arenaria and the fungus Sclerotium rolfsii were more severe in SP plots than in MBP plots. Also, Temik (3.4 kg ai/ha), the soil fungicide SN84364 (2.2 kg ai/ha), and the combination increased yields 14%, 52% and 81%, respectively. Two formulations of methyl bromide applied without tarp reduced M. arenaria damage and increased peanut yields. The greatest increase of 823 kg/ha occurred for Terr-O-Cide (67 kg ai/ha). Temik (1.7 kg ai/ha) applied postplant to the methyl bromide treated plots increased yields an average of 672 kg/ha. A proprietary nematicide, F5145, reduced M. arenaria damage and increased peanut yields at two rates: 4.9 kg ai/ha, 738 kg/ha and 7.4 kg/ha, 659 kg/ha. Yield differences were not significant when soybean was planted by the SP method in rye stubble and in fallow soil infested with M. incognita. However, cultivar yields were different and Temik (3.4 kg ai/ha) increased yields 61.5%. Host tests and morphological features of a Meloidogyne incognita isolate were not typical for any previously described M. incognita race. Improved nematode, disease and insect control in MT and conventional tillage will increase profits and/or reduce soil erosion which will benefit the producer and consumer.

Publications: 87/01 to 87/12
MINTON, N.A., GOLDEN, A.M., and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.
MINTON, N.A., LEONARD, R.A., and PARKER, M.B. 1987. Concentration of phenamiphos in the profile of a sandy loam soil as affected by tillage and time. J. Nematol. 19:544. (Abstract).
MINTON, N.A., and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. J. Nematol. 19:38-43.
SUMNER, D.R., and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

23.028* CRIS0090950
NEMATODE PATHOLOGY, RESISTANCE AND CONTROL ON FIELD AND FORAGE CROPS

MINTON N A; Plant Pathology; Georgia Coastal Plain Expt Sta, Tifton, **GEORGIA** 31794.
Proj. No.: GEO-02-0218 Project Type: STATE
Agency ID: SAES Period: 01 NOV 83 to 31 OCT 87

Objectives: Study the pathology caused by nematodes and associated organisms infecting plants and integrate nematode controls that may include resistant varieties, chemicals, and cultural practices into systems for control of other pests consistent with cultural practices that minimize the use of chemicals and energy, maximice soil conservation, and improves per unit production.

Approach: Field experiments involving multiple cropping, resistant varieties, winter legumes, cultural practices, and chemicals will be conducted to develop systems of pest control. Greenhouse experiments to determine the interaction of nematodes with other organisms and to evaluate germplasm for nematode resistance will be conducted.

Progress: 83/11 to 87/10. Pratylenchus safaensis was reported in the U.S. (GA) and Meloidogyne graminicola in GA for the first time. Internal stem discoloration in Cobb soybean was more severe in soil infested with Fusarium oxysporum f. sp. tracheiphilum race 1, Belonolaimus longicaudatus and P. brachyurus than with only the fungus. Nematodes (M. arenaria, P. brachyurus), white mold (Sclerotium rolfsii), and insects of peanuts double-cropped after wheat were managed equally well in minimum-tiled (MT) and moldboard plowed (MB) soil. Yields in 9 experiments were increased an average of 5.5% by a nematicide and 13.3% by a soil fungicide + insecticide and MB plots yielded 7.8% more than MT plots. Numbers of M. incognita in soybean were greater in fallowed than in rye plots, but soybean yields were the same. Soybean yields were greater in MT than in MB plots. Ethylene dibromide reduced numbers of nematodes and increased yields more consistently than did aldicarb and phenamiphos. Crimson clover preceeding irrigated corn planted MT had little effect on M. incognita and Paratrichodorus minor. Phenamiphos at 2.8 kg ai/ha increased corn yields 16%. Hoplolaimus columbus populations were high under crimson clover, hairy vetch, common vetch and rye than in fallowed plots; phenamiphos 2.0 kg ai/ha did not control this nematode in corn planted MT and MB. Soil preparation (MT and MB) in rye stubble had little effect on phenamiphos in the soil profile up to 22 weeks after treatment.

Publications: 83/11 to 87/10
MINTON, N.A. 1986. Impact of conservation tillage on nematode populations. Journal of Nematology 18:135-140.
MINTON, N.A. and CSINOS, A.S. 1986. Effects of row spacings and seeding rates of peanut on nematodes and incidence of southern stem rot. Nematropica 16:167-176.
MINTON, N.A., GOLDEN, A.M. and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.
MINTON, N.A. and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. Journal of Nematology 19:38-43.
SUMNER, D.R. and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

23.029* CRIS0099920
INTEGRATING CONSERVATION TILLAGE INTO PEST MANAGEMENT LEVELS WITH CROP PRODUCTION SYSTEMS

JOHNSON A W; Plant Pathology; University of Georgia, Tifton, **GEORGIA** 31794.
Proj. No.: GEO-02-0227 Project Type: STATE
Agency ID: SAES Period: 01 OCT 86 to 30 SEP 89

Objectives: Develop integrated pest management systems utilizing conservation tillage in crop production systems in the Southeastern Coastal Plain.

Approach: Three cropping sequences of soybean, cotton, and triticale (1-year double cropping sequence of soybean-triticale; 1-year double cropping sequence of cotton-triticale; and a 2-year cycle of cotton-triticale-soybean-triticale) will be established under conservation tillage (at least 30% of the preceding crop residue will be maintained at or near the soil surface), irrigation, and optimum and minimum pest management levels. Nematode population densities, root-gall indices, soil-borne pathogens, weeds, and insects will be monitored on monthly or other predetermined schedules. Crop response parameters such as stand, growth characteristics, quality, and yield will be measured. The research will be conducted in cooperation with plant pathologists, horticulturists, weed scientists, agronomists, entomologists, agricultural engineers, pesticide residue chemists, and economists.

Progress: 87/01 to 87/12. Ridge-plant, no-till, row-till and deep-turn tillage treatments were established on triticale (T) following cotton (C). Yields of T from deep-turn, row-till, and ridge-plant were 24%,

13%, and 2% greater, respectively, than yield from no-till treatment. After harvest of T, the stubble residue was mowed tall (60 cm), mowed short (20 cm), or burned. C 'McNair 235', resistant to Meloidogyne incognita, was planted on tillage treatments as described for T. Numbers of spiral nematodes, Helicotylenchus dihystera, ranged from 145 to 775/150 cm soil on T and 145 to 1100/150 cm on C, but were not affected by tillage methods or residue management. Three cropping systems, T-C; T-soybean (SB); and T-C-T-SB were established under irrigation and optimum (fenamiphos

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

23.030 CRIS0097711
GENETIC IMPROVEMENT OF SOYBEAN

BOERMA H R; Agronomy; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000884 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 86 to 31 DEC 90

Objectives: Develop multiple pest resistant cultivars for full-season and double-crop production. Determine the inheritance of resistance to three species of root-knot nematode. Determine the inheritance of tolerance to Heterodera glycine (SCN). Determine the host genes controlling resistance to cowpea chlorotic mottle virus. Evaluate the effectiveness of natural selection for resistance to SCN. Determine the agronomic potential of the brachytic and nitrate-tolerant traits. Develop germplasm with new sources of resistance to foliage- and pod-feeding insects. Identify germplasm with superior canopy photosynthesis.

Approach: Make sexual crosses among parents with the extreme expression of traits under study. Select or classify the various phenotypes in the segregating generations. Measure yield and agronomic performance of selected genotypes in four Georgia environments.

Progress: 87/01 to 87/12. In 1987 this project was responsible for the release of 'Twiggs' soybean. It was released because of its multiple nematode resistance, field resistance to stem canker, and high productivity. Twiggs was derived from an F(5) plant from the cross 'Centennial' x 'Forrest'. It is the early Group VI maturity. In the absence of nematode infestations, Twiggs has been equal or superior in seed yield to cultivars of similar maturity, but when grown in soil infested with soybean cyst nematode Race 3 (Heterodera glycines Ichinohe) or southern root-knot nematode (Meloidogyne incognita), seed yield has been superior. Twiggs is resistant to the soybean cyst nematode Races 1 and 3 and to M. incognita and M. javanica. It has moderate resistance to M. arenaria. A study was undertaken to determine the relationship of canopy - apparent photosynthesis (CAP) and seed-fill period to seed yield. Twenty genotypes in Maturity Groups (MG) V, VI, and VII were grown near Athens, GA for 2 years. The genotypes consisted of seven recently developed cultivars (RC), seven plant introduction (PI), which had been previously identified as having high seed yield, three high photosynthetic cultirvars (HPC), and three low photosynthetic cultivars (LPC). Five CAP measurements were taken during the reproductive stage of development. When averaged over maturity groups, the RC were 5% higher in CAP than the LPC and 13% higher than the PI. The RC and HPC had 4 to 5 days longer seed-fill period than PI or LPC.

Publications: 87/01 to 87/12

LUZZI, B.M., BOERMA, H.R. and HUSSEY, R.S. 1987. Resistancce to three species of root-knot nematode in soybean. Crop Sci. 27:258-262.
PAGUIO, O.R., BOERMA, H.R. and KUHN, C.W. 1987. Virus concentration, disease resistance, and agronomic performance of soybean infected with cowpea chlorotic mottle virus. Phytopathology 77:703-707.
PURCELL, L.C., ASHLEY, D.A. and BOERMA, H.R. 1987. Effects of chilling on photosynthetic capacity and leaf carbohydrate and N status of soybean. Crop Sci. 27:90-95.
BOERMA, H.R., HUSSEY, R.S. and REESE, P.F., JR. 1987. Tolerance to soybean cyst nematode. Proceed. of the Sixteenth Soybean Seed Res. Conf. 16:76-83. Chicago, IL.
TODD, J.W., BEACH, R.M., ALL, J.N. and BOERMA, H.R. 1987. Overview of the Georgia soybean breeding program for host plant resistance. An. Plant Resis. to Insects Newsl. 13:7-10.
REESE, P.F., JR. 1987. Soybean tolerance to Heterodera glycines. Ph.D. Diss. Univ. Georgia, Athens, 68 p.
WALLER, R.S. 1987. Effects of tolerance and initial soybean cyst nematode population density on reproductive advantage of resistant soybean genotypes. M.S. Thesis. Univ. Georiga, Athens, 61 p.

23.031* CRIS0135108
MAXIMIZING THE UTILITY OF ENTOMOGENOUS PATHOGENS IN CROP PRODUCTION SYSTEMS

GARDNER W A; Entomology; University of Georgia, Griffin, **GEORGIA** 30223.
Proj. No.: GE001419 Project Type: HATCH
Agency ID: CSRS Period: 01 AUG 88 to 31 JUL 91

Objectives: Quantify the impact of agrichemicals, soil antagonists, and target pest movement patterns on the persistence, stability, and efficacy of entomogenous fungi and nematodes in selected soils; determine and analyze biotic and abiotic factors that regulate natural epizootics of entomopathogens; evaluate methods to enhance the activity of the bacterium Bacillus thuringiensis against polyphagous lipidopteran pests; screen and manipulate pathotypes of selected entomogenous fungi to yield isolates resistant to antagonistic agents.

Approach: Laboratory, greenhouse, and field studies will investigate the impact of herbicides and soil microorganisms on the survivorship of entomogenous fungi and

nematodes. Beauveria bassiana, Steinernema, and Heterorhabditis will serve as models. Regression procedures will be used to define key factors governing epizootics of entomogenous fungi. Controlled laboratory and greenhouse studies will further delineate the role of environmental factors in their epizootiology. Dose/mortality responses, feeding inhibition, and foliage consumption will be measured in laboratory studies. Field trials of efficacy will follow. Repeated subculturing and induced mutagenesis will be utilized to select for increased resistance of B. bassiana to antagonistic herbicides.

23.032 CRIS0097587
QUANTIFICATION OF SOYBEAN CYST NEMATODE DAMAGE TO SOYBEAN ROOT SYSTEMS FOR INTEGRATION INTO CROP MODEL

HUSSEY R S; RADCLIFFE D E; KARNOK K J; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GEO-RC299-119 Project Type: CRGO
Agency ID: CRGO Period: 30 SEP 85 to 30 JUN 88

Objectives: Determine influence of H. glycines on soybean root and shoot development in field microplots and rhizotron. Model effects of H. glycines on soybean growth and incorporate this component into the SICM model.

Approach: Plant growth parameters and root distribution will be compared throughout the growing season on H. glycines susceptible intolerant (Bragg) and tolerant (Wright) cultivars growing in field microplots infested with increasing cyst nematode densities. Nematode biomass within the root system will be used to calculate the demand of the parasitic nematodes for photosynthate. Experiments will also be conducted in the UGA rhizotron to evaluate root and shoot growth characteristics of these genotypes (Bragg and Wright) grown in soil infested with increasing levels of cyst nematodes and noninfested soil. The relationship between nematode inoculum levels and root length density reduction and the response of the plant to nematode root damage will be developed into a mathematical model and incorporated into the Soybean Integrated Crop Management model.

Progress: 87/01 to 87/12. A study was conducted in a rhizotron to evaluate tolerance of the soybean to the sybean cyst nematode. Detailed root and shoot observations were made on cultivars Wright (tolerant) and Bragg (intolerant) grown under three nematode population densities. Under the highest nematode density Wright exhibited tolerance to nematode damage with greater seed weight, less pod abortion, greater vegetative production, anda greater percentage of root length (based on control) than Bragg. The earliest display of tolerance was stimulated root development on infected Wright, while root development for Bragg was suppressed. These same cultivars were grown for a second year in field microplots infested with four population densities of the cyst nematode to model the effects of the nematode on soybean growth. Analyses were performed on plant and soil samples obtained at five intervals throughout the growing season. Soybean plant data consisting of leaf, stem, pod, seed, and root mass as well as leaf area and root length density were averaged over replications and converted to a per unit area basis consistent with the SOYGRO crop growth model format. Low nematode population densities caused some growth stimulation for both cultivars. At the high nematode inoculum density, both cultivars showed marked yield suppression and the percentage reduction (based on control) was greater for Bragg than Wright.

Publications: 87/01 to 87/12
MILTNER, E.D., KARNOK, K.J. and HUSSEY, R.S. 1987. Tolerance of soybean to the soybean cyst nematode: a rhizotron study. Proceedings So. Soybean Disease Workers 14:32 (Abstr.).

23.033 CRIS0141787
SOYBEAN CYST NEMATODE VARIABILITY, POPULATION DYNAMICS, AND METHODS FOR EFFICIENT CONTROL

NOEL G R; Agricultural Research Service, Urbana, **ILLINOIS** 61801.
Proj. No.: 3611-24000-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 APR 86 to 31 MAR 91

Objectives: 1) Characterize soybean cyst nematode (SCN) races using isozymes; 2) evaluate as biological control agents a rickettsia-like organism and fungi iso-lated from infected SCN in Illinois; and 3) develop SCN control using resistant germplasm, nonhost crops and pesticides.

Approach: SCN populations will be characterized by number of isozymes detectible fromindividual females. Changes in SCN aggressiveness when challenged by re- sistant plants will be determined by observing differences in genotypic ex-pression of isozymes and comparing to original populations. A rickettsia- like organism that attacks SCN will be identified. Pathology of diseased nematodes and transovarial transmission will be investigated. Pathogen- icity of fungi that attack SCN will be evaluated by determining SCN popula-tions resulting from concomitant infestation of soybean rhizosphere with fungi and SCN eggs and juveniles. SCN hatch stimulation by maize herbi- cides will be compared to SCN hatch in soybean root exudate and water. Stimulatory herbicides will be evaluated in the field by determining SCN population dynamics and nematode attrition. Rotation of maize treated withherbicides that stimulate SCN hatch will be integrated with low rates of nematicides and new sources of nematode resistance.

Progress: 87/01 to 87/12. Exudates from corn roots inhibited soybean cyst nematode hatch. Susceptible and resistant soybeans stimulated hatch equally. The primary esterase affected by the nematicides aldicarb and phenamiphos is carboxylesterase. Little acetycholinessterse was detected in female nematodes.

Acetycholinesterse was detected histochemically in juveniles and was inhibited by both nematicides. Nematode exterase exhibited differences in substrate specificity and kinetics of inhibition when compared to classical studies done with mammalian systems. Yields of susceptible and resistant soybeans in maturity groups III, IV, and V were not significantly different when treated with the nematicides aldicarb, carbofuran, and phenamiphos applied in-furrow and offered no economic advantage over yields obtained with 20 public and private soybean cyst nematode-resistant varieties without nematicide treatment.

Publications: 87/01 to 87/12

LIM, S.M., APPLE, J.A., NDEL, G.R., EDWARDS, et.al. 1987. Multiple pest effects in soybean. IN: CIPM integrated pest management on major agricultural systems. R.E. Frisbee and P.L. Adkisson, eds., pp. 391-408.

NDEL, G.R. 1987. Comparison of "Fayette" soybean, alldibarb, and experimental nematicides for control of Heterodera glycines on sobyean. Ann. Appl. Nematol.

NDEL, G.R. and MAYASICH, S.M. 1987. Partial characterization of esterase from Heterodera glycines and inhibition by two nematicides. J. Nematol. 19:547.

FAGBENLE, H.J., EDWARDS, D.I. and MALEK, R.B. 1988. Effects of temperature on emergence of juveniles and root invasion of two populations of Heterodera lespedezae. Nematologica. Accepted Dctober 10, 1987.

STANGER, B.A. and NDEL, G.R. 1988. Scanning electron microscopy of vulvalcones of Heterodera glycines and three related cyst nematode species, J. Nematol. 20: Accepted November 10, 1987.

EDWARDS, D.I. 1988. The soybean cyst nematode. Proc. North Central RegionSoybean Disease Workshop. American Phytopathological Society. Acepted December 10, 1987.

23.034* CRIS0074740

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

MALEK R B; Plant Pathology; 1301 West Gregory Drive, Urbana, **ILLINOIS** 61801.

Proj. No.: ILLU-68-0381 Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 88 to 30 SEP 93

Objectives: Determine the variability in nematode-host interactions and determine the relationships among host, abiotic factors, and crop losses caused by plant parasitic nematodes.

Approach: The impact of primary crop species and cultivars on populations of principal nematode parasites under greenhouse and field conditions will be analyzed using mono- and polyspecific nematode communities. Temperature and moisture effects on nematode developmental biology, population development and pathogenicity will be clarified under controlled conditions. Growth and yield responses of primary crops to parasitism by nematodes under field conditions will be correlated with annual growing season weather, soil type, tillage practice and fertility regime.

Progress: 86/10 to 87/09. Post-emergence application of liquid nitrogen to dent corn via simulated fertigation in mid and late June to mitigate early-season damage to plants by the needle nematode Longidorus breviannulatus on sandy soil not treated with a nematicide increased yield 48% over that of corn fertigated once at double-rate in late June in 1986 (data not available at reporting time). Yield of the twice-fertigated, untreated corn was 30% less than that of similarly fertigated corn treated at planting with aldicarb and was equivalent to yield of untreated corn sidedressed with dry nitrogen between rows twice in June. Nitrogen fertigation in early in fertigation in early, mid and late June in 1987 improved stand appearance of nematode-damaged seedlings on untreated soil, but plant response was less than in 1986 beacuse of unusually rapid crop development. Under abnormally high early-season temperature conditions and in contrast to results in the prior year, at-planting treatment with aldicarb provided much abbreviated protection of roots from parasitism by L. breviannulatus and did not effectively suppress nematode population development. Yield comparison data are not yet available.

Publications: 86/10 to 87/09

ND PUBLICATIDNS REPDRTED THIS PERIOD.

23.035* CRIS0095489

THE NEMATODE COMPONENT OF ROOT DISEASE-SOIL INSECT COMPLEXES OF FIELD CROPS

MELTON T A; Plant Pathology; 1301 West Gregory Drive, Urbana, **ILLINOIS** 61801.

Proj. No.: ILLU-68-0363 Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 85 to 30 SEP 88

Objectives: Determine the interrelationships of nematodes and their population dynamics with other soil biological factors, soil types, corn and legume yields, cropping sequences, host genotypes, and economic thresholds and integrate results into crop protection models for corn and legume crops.

Approach: A sequential approach will be used. Various combinations of biotic and abiotic factors first will be tested under controlled conditions of the greenhouse to determine their interrelationships with nematode populations. Significant interactions will be studied further under semicontrolled conditions such as in microplots, where soil biotic factors will remain controlled but natural climate and edaphic factors may influence results. Models will be created or updated to reflect new data. Finally, multiple testing of models will be conducted under field conditions, where all biotic and abiotic factors can interrelate.

Progress: 86/10 to 87/09. Greenhouse studies using F2 isogenic lines of Dh 43 (normal DIMBDA), Dh 43 bx (low DIMBDA), A632, A632 (low

DMBDA), and the inbreds C 123 (excellent host), bx/bx (very low DIMBDA), and BX/BX (high DIMBDA) showed differences (P=0.05) in host suitabilities for Pratylenchus scribneri. Low DIMBDA lines were good hosts, whereas normal or high DIMBDA lines were poor hosts. P.scribneri populations on A632 bx and Oh43 bx were more than ten times the size of the A632 and Oh43 populations. Based on orthogonal contrasts these differences were highly significant (P=0.005). Dther inbreds are being tested as well as possible mode of actions of DIMBDA. These results provide a basis for more work to determine if DIMBDA is a major mechanism for resistance of corn to P. scribneri. Because DIMBDA concentration is determined by a single gene, resistance could be incorporated into modern hybrids. The mutant bx/bx has been backcrossed to the F3 generation in A632 and Oh43, and to the F2 generation in B37, Mo17, H99, H60, and LH38. These inbreds will be tested to determine the role of DIMBDA as a mechanism for P. scribneri and P. hexincisus.

Publications: 86/10 to 87/09
MELTDN, T.A. and SIMCDX, K.D. 1987. Effects of 2,4-Dihydroxy-7-methoxy-2H 1, 4-benzoxazin-3(4h)-one (DIMBDA) in corn lines on reproduction of Pratylenchus hexincisus. J. Nematology 19:543. (Abstr.).

23.036 CRIS0014770
AUTECOLOGY AND CONTROL OF SOILBORNE PLANT PATHOGENS

GREEN R J JR; Botany & Plant Pathology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IND055013 Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 84 to 30 SEP 89

Objectives: To ellucidate the causal factor(s) in the "decline complex" of the peppermint cultivars Mentha piperita cv's Todd's Mitcham and Murray Mitcham. Initiate studies on the biosuppression of the weed species velvetleaf Abutilon theophrasti and the ecology of Verticillium dahliae in relation to this plant species. Make final field evaluations of selected irradiation-induced mutants of scotch spearmint Mentha cardiaca resistant to V. dahliae.

Approach: The causal factor(s) of the decline complex of peppermint Mentha piperita will be identified through isolations from affected plant parts. Greenhouse studies will attempt to duplicate the disease complex by control of soil and other environmental conditions for further study. Field plots will be treated with selective biocides to control known nematodes, insects and microbial pathogens. The population dynamics of propagules of V. dahliae in soil will be followed with velvetleaf Abutilon theophrasti and the subsequent biosuppression of the weed population. Selected mutants of scotch spearmint resistant to V. dahliae will be field tested in IN, MI and WA for final selection, increase and release to growers.

Progress: 87/01 to 87/12. A 3 year study of the causal factors associated with the "decline complex" in old fields of peppermint Mentha piperita cv Murray Mitcham was completed. Decline of roots and overwintering stolons was associated with infection and colonization by, in order of frequency, Fusarium spp. Rhizoctonia solani, Pythium spp. Alternaria spp. and Sphaceloma menthae. There was also a significant increase (P=05) in infection by Verticillium dahliae and the lesion nematode Pratylenchus penetrans. Decline was more severe in previously fumigated plots after 3 years when on-farm rootstocks were used in the original planting compared to disease-free stocks. A survey of 25 peppermint fields 3 years or older selected at random in 3 different areas of IN for incidence and level of populations of P. penetrans showed populations as follows: 0=7 fields; 10-100=4 fields; 100-400=6 fields; 400-800=3 fields; 800-2000=2 fields; 2000-5000=1 field & 5000+=2 fields. Counts were based on ave. nemas/g dry root. Critical levels for crop injury are 2000+/g dry root. Consistent evidence cannot be demonstrated of cross-protection of tomato cvs resistant to Fusarium oxysporum f. sp. lycopersici (FOL) but susceptible to Verticillium dahliae (VD) when inoculated simultaneously with these pathogens. Cvs with either "I" gene or multiple gene resistance to FOL exhibited a different disease response to VD than susceptible cvs regardless of whether simultaneously inoculated with FOL/VD or not.

Publications: 87/01 to 87/12
ND PUBLICATIDNS REPDRTED THIS PERIDD.

23.037* CRIS0023589
MANAGEMENT AND CHARACTERIZATION OF SELECTED PLANT PARASITIC NEMATODES

FERRIS J M; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IND058019 Project Type: HATCH
Agency ID: CSRS Period: 13 FEB 84 to 30 SEP 89

Objectives: Assess the influence of biotic and abiotic factors on the development and impact of selected nematode pest species. Study morphological, macromolecular and behavioral differences among disjunct populations of namatode pest species. Evaluate and refine crop-nematode models for predicting yield loss and devising control strategies.

Approach: Collect qualitative and quantitative data on target nematode species, with special emphasis on variability among disjunct populations. Determine yield losses under varied field conditions and cropping procedures, and differential responses of breeding lines to different nematode populations. Incorporate new data in crop-nematode models for use in pest management schemes.

Progress: 86/10 to 87/09. For soybean cyst nematode (SCN) analyses were continued in experiments to assess the relationship between greenhouse susceptibility data for resistance (based on numbers of developing cysts) and field susceptibility tests (based on nematode counts and/or yield data). In the experiments pots containing soybean test lines were buried

alongside hill-plot tests of the same lines in 2 field locations. Cyst and egg counts were made at each field site at planting and before harvest (buried pots) to determine development of SCN under field conditions, and yield (hill plots) was recorded for each host line entry. Soil from the same field was used to obtain inoculum to infest greenhouse seedlings of each enttry with eggs and juveniles. Greenhouse cyst and egg counts were made at 6 weeks. Regression analyses, using means of data from 5 replicates of each field and greenhouse entry, showed correlations between greenhouse cyst and egg counts (R = 1.00), greenhouse and final field egg counts (R = 0.90), yield and final field egg count (R = 0.68) and yield and greenhouse cyst counts (R = 0.62). Additional field tests were conducted at 4 Indiana locations to evaluate 54 soybean lines (25 Group II and 29 Group III) of the 1987 Regional SCN Test for resistance to SCN and yield. The hill-plot tests, 2 in Pulaski, 1 in Tippecanoe, and 1 in Vigo County were planted in grower fields infested with SCN. In addition, soil from each location was used in greenhouse screening tests of the same 54 lines.

Publications: 86/10 to 87/09

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic concepts and methods. Pages 346-353 in J. A. Veech and D. W. Dickson, eds. Vistas on Nematology. 25th anniversary volume of the Society of Nematologists.

FERRIS, V.R. and FERRIS, J.M. 1987. Two-dimensional protein patterns in Heterodera avenae. Review Nematologie 9:295-296.

FERRIS, V.R., FERRIS, J.M. and FAGHIHI, J. 1987. Two-dimensional protein patters of strains and pathotypes in Heterodera avenae. J. Nematol. (in press).

FAGHIHI, J., FERRIS, J.M. and FERRIS, V.R. 1987. Relationship between greenhouse and field suscptibility tests of SCN resistant soybean lines. J. Nematol. (in press).

FERRIS, V.R., FERRIS, J.M., MURDOCK, L.L. and FAGHIHI, J. 1987. Two - dimensional protein patterns in Labronema Aporcelaimellus and Eudorylaimus (Nematoda:Dorylaimida). Journal of Nematology (in press).

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic analyses in Dorylaimida using data from 2-D protein patterns. J. Nematol. (in press).

23.038* CRIS0023614

NEMATODE COLLECTION AND SYSTEMATICS

FERRIS V R; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.

Proj. No.: IND058020 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To continue to develop testable hypotheses of evolution in time and space for selected groups of free-living and plant parasitic nematodes. To continue development of the Purdue Nematode Collection as a basis for research.

Approach: Obtain data on morphological, behavioral and macromolecular characters for variability in populations and species of selected taxa, reevaluate species limits, and analyze by cladistic methods to develop phylogenies and to determine whether geographic distributions should be interpreted as the result of vicariance patterns or dispersal. Continue with curatorial care of the Purdue Nematode Collection, and make new collections as necessary to provide experimental materials and for management of pest species.

Progress: 86/10 to 87/09. Considerable progress was made in the comparative analysis of 2-dimensional (2-D) protein patterns in free-living nematode species of the Dorylaimida. Among 6 geographical isolates in the genus Labronema the 2-D protein patterns for 2 isolates from Indiana were found to be nearly identical to the pattern for L. vulvapapillatum from Europe. Morphological and life history data subsequently verified the conspecificity of these three isolates. The pattern for a nominal isolate of L. pacificum from south Florida was very different from the patterns of nominal L. pacificum isolates from Hawaii and Fiji, which had patterns very similar to each other, although a few differences in small spots distinguished the two Pacific isolates from each other. In a Jaccard analysis to obtain a quantitative estimate of the phenetic similarity among the isolates, the European isolate had a similarity coefficient (SC) of 0.932 with the 2 Indiana isolates, which were identical to each other (SC = 1.000). The SC for the 2 Pacific isolates was 0.887. The Florida isolate had a much lower pairwise SC with all the other isolates,ranging from 0.333 to 0.389. The Florida isolate had a lower SC with the Pacific isolates than with the isolates of L. vulvapapillatum, even though it had originally been considered conspecific with the Pacific isolates based on morphological data.

Publications: 86/10 to 87/09

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic concepts and methods. Pages 346-353 in J.A. Veech and D. W., Dickson, eds. Vistas on Nematology. 25th Anniversary volume of the Society of Nematologists.

FERRIS, V.R. and FERRIS, J.M. 1987. Two-dimensional protein patterns in Heterodera avenae. Revue Nematologie 9:295-296.

FERRIS, V.R., FERRIS, J.M. and FAGHIHI, J. 1987. Two-dimensional protein patterns of strains and pathotypes in Heterodera avenae. J. Nematol. (in press).

FAGHIHI, J., FERRIS, J.M. and FERRIS, V.R. 1987. Relationship between greenhouse and field susceptibility tests of SCN resistant soybean lines. J. Nematol. (in press).

FERRIS, V.R., FERRIS, J.M., MURDOCK, L.L. and FAGHIHI, J. 1987. Two - dimensional protein patterns in Labronema, Aporcelaimellus and Eudorylaimus (Nematoda: Dorylaimida). Journal of Nematology (in press).

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic analyses in Dorylaimida using data from 2-D protein patterns. J. Nematol. (in press).

23.039 CRIS0134823
IMPROVED PEST MANAGEMENT SYSTEM FOR A NEMATODE-WEED-INSECTCOMPLEX

PEDIGO L P; NORTON D C; OWEN M K D;
Entomology; Iowa State University, Ames, **IOWA** 50011.
Proj. No.: IOWO2871 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 88 to 31 MAY 90

Objectives: To develop an integrated methodology for studying concurrent and sequential impacts of pest complexes and management tactics in soybean production, to determine individual and potential interactive effects of injury from cyst nematode, herbicide applications, and simulated insect defoliation on soybean morphology, physiology, phenology, and seed production, to establish mathematical models of yield loss, plant stress, and pest density, to develop interactive economic-injury levels and appropriate recommendation algrorithms for a nematode-weed-insect complex in the North Central Region.

Approach: Plots of BSR 201 soybeans will be established in a nematode-infested field near Ames, IA. Treatments will consist of 2 nematode levels, 3 postemergence herbicide levels, and 4 simulated insect-defoliation levels. A complete randomized block with 4 replications will be used. Data will be gathered on nematode and other pest populations as well as plant morphological and physiological characteristics, including yield. The data will be analyzed to characterize plant stress and allow construction of yield-loss models. These models will be used to develop economic injury levels and management recommendations for the pest complex.

23.040 CRIS0134670
SOYBEAN DISEASE RESISTANCE SCREENING

EPSTEIN A H; NORTON D C; TACHIBANA H; Plant Pathology; Iowa State University, Ames, **IOWA** 50011.
Proj. No.: IOWO2869 Project Type: STATE
Agency ID: SAES Period: 01 JUL 88 to 30 JUN 93

Objectives: Establish an ongoing comprehensive soybean disease resistance screening program to identify soybean germ plasm and cultivars resistant to the major yield limiting diseases in Iowa: Phytophthora root rot (Phytophthora megasperma sojae), brown stem rot (Phialophora gregata), and soybean cyst nematode (Heterodera glycines).

Approach: Soybean lines obtained from the soybean breeding program at Iowa State University will be screened for resistance to the various pathogens. Inoculum representing the various pathotypes present in Iowa will be maintained in viable, virulent state for this purpose. Research will be conducted to develop improved methods for inoculum preservation and disease resistance screening.

23.041* CRIS0074750
INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

NORTON D C; POLLAK L; Plant Pathology; Iowa State University, Ames, **IOWA** 50011.
Proj. No.: IOWO2285 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the intraspecific variability of plant-parasitic nematodes. Determine the variability in nematode-host interactions. Determine the relationships among host, abiotic factors, and crop losses caused by plant-parasitic nematodes.

Approach: Evaluate corn inbred and hybrid genotypes for resistance to Pratylenchus hexincisu and P. scribneri in the field and greenhouse. Germ plasm will be obtained from plant breeders and other collections such as the USDA Plant Introduction Stations. Improve for resistance to the above nematodes through crosses of resistant lines including exotic germ plasm such as Zea diploperennis. Investigate patterns of resistance based on DNA sequence analysis.

Progress: 87/01 to 87/12. Zea diploperennis and Z. perennis, in separate previous experiments, have shown promise in having resistance to the lesion nematode, Pratylenchus spp. These cultivars were tested side by side in the field and in the greenhouse in 1987. Both B.diploperennis and Z. perennis were poor host for Pratylenchus hexinisus or P. scribneri compared with Mo17Ht x B73Ht. After 103 days in the greenhouse, numbers of Pratylenchus per gram of dry root were reduced by 82 and 98 percent by Z. perennis and Z. diploperennis, respectively, relative to Mo17Ht x B73Ht. Numbers of Pratylenchus increased 60 fold in Mo17Ht x B73Ht during the experiment. In the field, samples were taken three times after planting and numbers of Pratylenchus per gram of dry root decreased from 76 to 96 and from 67 to 91 percent for Z. diploperennis and Z. perennis, respectively, relative to Mo17Ht x B73Ht, depending on the sampling date. Numbers of Hoplolaimus galeatus per gram of dry root decreased from 46 to 87 percent and 34 to 94 percent for Z. dipleperennis and Z. perennis, respectively, relative to Mo17Ht x B73Ht, depending on the sampling date. Work has been started on screening primitive maize lines for resistance to Pratylenchus spp.

Publications: 87/01 to 87/12

HAKIMI, M.S. 1987. Population changes of plant-parasitic nematodes on maize and soybean cultivars. M.S. Thesis. Iowa State Univ., Ames. 101p.

NORTON, D.C. and EDWARDS, J. 1988. Age structure and community diversity of nematodes associated with maize in Iowa sandy soils. J. Nematol. Accepted for publication.

23.042 CRIS0079186
EVALUATION OF SOYBEAN LOSSES DUE TO NEMATODES IN IOWA

NORTON D C; NIBLACK T L; NYVALL R F; Plant Pathology Seed & Weed Science; Iowa State University, Ames, **IOWA** 50011.
Proj. No.: IOW02375 Project Type: STATE
Agency ID: SAES Period: 01 OCT 84 to 30 SEP 89

Objectives: Evaluate losses due to the soybean cyst nematode, Heterodera glycines, in Iowa. Aid in the development of high yielding cultivars with resistance to H. glycines. Evaluate other control measures for H. glycines including cultural, chemical and biological means. Evaluate the possible interactions between H. glycines and other organisms.

Approach: Soybean yields will be correlated with H. glycines population development over the season in plots treated or not treated with nematicides to approximate the damage caused by the nematode. In cooperation with Illinois, regional H. glycines resistant variety trials will be conducted on infested land for group two soybeans in north central Iowa and group three soybeans in southeast Iowa. The effects of crop rotation with nonhosts of H. glycines and resistant and susceptible soybeans will be evaluated. Blend tests with H. glycines resistant and brown stem rot resistant cultivars will be conducted at several locations infested with both causal organisms to study possible interactions between the two factors and their implications for future control measures.

Progress: 87/01 to 87/12. During 1987, our survey increased the known distribution of the soybean cyst nematode (SCN) from 23 to 30 Iowa counties. Included in race determination studies were 22 field isolates of SCN, of which 3 were Race 1, 1 was Race 2, 16 were Race 3, and 2 were Race 5. The greenhouse technique we developed in 1986 was used to screen 8,007 soybean breeding lines for resistance to SCN. The hill plot technique we deeloped was used at 2 locations to screen 103 lines of which 43 were from regional trials and 60 were from those identified as SCN-resistant in our greenhouse program. Differences in results obtained at the two locations were due to soil types and genetic differences between SCN isolates. Field studies were conducted in Hancock and Boone counties to quantify yield losses due to natural infestations of SCN and possible interactions among SCN, brown stem rot (BSR), root and stem rot (RSR), and iron deficiency chlorosis, using cultivars representing a range of reactions to all four. No consistent interactions were identified with BSR or RSR and SCN. Iron deficiency chlorosis-susceptible cultivars yielded less than resistants without regard to SCN reaction. Yield losses attributable to SCN alone ranged from 16.2 to 41.6%. Maturity of some susceptible cultivars was delayed for an average of 3.5 days. SCN populations near harvest were not affected by nematicide treatment at planting. SCN populations were higher in plots of susceptible than resistant cultivars.

Publications: 87/01 to 87/12
NIBLACK, T.L. 1987. Soybean nematodes in the north central United States. Proceedings of the North Central Region Soybean Disease Workshop. APS (in press).

23.043* CRIS0131304
NEMATODE ECOLOGY AND HOST-PARASITE RELATIONS IN NATURAL AND AGRONOMIC SYSTEMS

TODD T C; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN00662 Project Type: STATE
Agency ID: SAES Period: 01 JUL 87 to 30 JUN 90

Objectives: Investigate the interrelationships of nematodes and other soil biota in native tallgrass prairie. Assess the role of nematode interaction w/ other organisms in selected plant diseases in Kansas. Develop nematode management strategies specific for Kansas.

Approach: The effects of experimental manipulation of the biotic communities of native tallgrass prairie soils on nematode population dynamics will be monitored. The involvement of nematodes in disease complexes will be studied through single and multiple species inoculations in field microplots and in the greenhouse. Agronomic management practices will be evaluated for effects on nematode populations and selected for reduction or stabilization of target nematode densities.

Progress: 87/07 to 87/12. Second-year field studies of the interaction of the soybean cyst nematode, Heterodera glycines and the charcoal rot fungus, Macrophomina phaseolina were conducted in northeastern Kansas. Eight SCN-susceptible 4 SCN-resistant soybean genotypes were planted in eight-row plots at two locations. Carbofuran was applied at-planting to 4 rows of each entry. Preliminary results indicate that, for the second year, incidence of charcoal rot was positively correlated with early season SCN infection levels. The soybean entries K1126, K1140, K1143, and C1653 displayed tolerance to the nematode under the conditions of the test. In greenhouse microplot studies, final root densities of H. glycines on the soybean cultivars Williams 82 and Pella were greater in the presence of M. phaseolina when the initial population level of the nematode was below 10,000 eggs. Establishment of H. glycines was evaluated in sandy loam, loam, and silt loam soils. Regression analysis indicated a sigmoidal relationship between nematode infection and initial population with establishment occurring at 100-300 eggs for all 3 soil types. In a study of the effects of fire, mowing, and nutrient amendments on native prairie soil fauna, initial results indicate varied responses by nematode trophic groups. In general, mowing decreased plant-feeding nematode densities but had no effect on bacterial- or fungal-feeding nematode populations while nutrient amendments enhanced total nematode population densities in unburned but not burned plots.

Publications: 87/07 to 87/12
TDDD, T.C., PEARSON, C.A.S. and SCHWENK, F.W. 1987. Effect of Heterodera glycines on charcoal rot severity in soybean cultivars resistant and susceptible to soybean cyst nematode. Annals of Applied Nematology 1:35-40.

23.044 CRIS0133748
ARTHROPOD INDUCED STRESS ON SOYBEAN: EVALUATION AND MANAGEMENT

BOETHEL D J; Entomology; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02665 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Quantify the response of soybean to arthropod-induced stress, characterize interactions between arthropods and other biotic and abiotic stresses and construct practical management tools to include economic injury levels and subcomponents for a soybean growth simulation model. Determine the impact of plant resistance on soybean arthropod communities and assess the interaction of plant resistance with biological and chemical control.

Approach: The effects of insect-induced defoliation (Pseudoplusia includens) on the N(2) fixing ability and photosynthesis of soybean will be determined in greenhouse studies. The impact of insect defoliation (P. includens), infection by the stem canker fungus (Diaporthe phaseolurum var. caublivora), and infestation by the soybean cyst nematode (Heterodera glycines) on soybean will be examined in the greenhouse and the field. The experimental design in all studies will be a CRD with factorial arrangement of treatments. The impact of resistant soybean genotypes on the population dynamics of predators and parasitoids of lepidopterous defoliators will be examined by monitoring populations in field plantings.

23.045 CRIS0099579
SOYBEAN GROWTH AND DEVELOPMENT: RESPONSE TO STRESS BY AN INSECT - DISEASE - NEMATODE COMPLEX

BOETHEL D J; BERGGREN G T; MCGAWLEY E C; Entomology; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02531 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 86 to 30 SEP 88

Objectives: To measure the response of soybean to stresses induced by insect defoliation, stem disease, and nematode infection, each alone and in combination. 2) To determine the response of a stem pathogen to sequential application of stress induced by insect defoliation.

Approach: Objective 1 - All experiments will utilize a CRD design with factorial arrangement of treatments to assess the individual and interactive effects of soybean looper defoliation and stem canker fungus and soybean cyst nematode infection on plant growth and development. Treatments will consist of four levels of defoliation and two levels each of stem canker and soybean cyst nematode (presence or absence) for a total of 16 treatment combinations, each replicated 8 times. Plant parameters measured will be photosynthetic rate, dry wt., nodule wt. and number, and N(2) fixation. Objective 2 - Sequential defoliation stress on stem canker fungus development will be examined using a completely randomized design with factorial arrangement of treatments. Treatments will be four levels of soybean looper defoliation and two soybean looper defoliation/stem canker fungus inoculation sequences for a total of eight treatment combinations each replicated 12 times. Plant parameters measured will be the same as described in Objective 1.

Progress: 87/01 to 87/12. Greenhouse studies were conducted on interactions among soybean looper (Pseudoplusia includens), a stem canker fungus (Diaporthe phaseolorum var. caulivora), and a soybean cyst nematode (Heterodera glycines). Populations of cyst nematodes in soil and roots were decreased significantly on plants with stem canker disease but were increased significantly when plants were defoliated upto 64% by soybean looper. Lengths of stem cankers were reduced up to 45% in plants whose root systems were infected by cyst nematode. A significant correlation was obtained between severity of stem canker disease and defoliation; canker lengths decreased as defoliation increased to 78%. Defoliated plants recovered and had leaf areas equal to those of controls 3-6 weeks after defoliation. Lengths of cankers that developed in recovered plants were similar to those in controls, which suggests a link between photosynthate supply and canker severity. Plant growth and N(2)-fixation were affected by insect, fungus, and nematode; all three pests reduced leaf area, stem dry weight, number and dry weight of N(2)-fixation. There were few significant interactions among these pests; in general, all effects were additive.

Publications: 87/01 to 87/12
RUSSIN, J.S., LAYTON, M.B., MCGAWLEY, E.C., BOETHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Interactions between soybean looper, stem canker fungus, and soybean cyst nematode on soybean. Phytopathology 77: (in press) (Abstract).
LAYTON, M.B., RUSSIN, J.S., MCGAWLEY, E.C., BOWTHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Effects of insect-induced defoliation, stem canker disease, and soybean cyst nematode on soybean growth and N(2)-fixation.
RUSSIN, J.S., LAYTON, M.B., BOETHEL, D.J., MCGAWLEY, E.C., SNOW, J.P. and BERGGREN, G.T. 1988. Population development by Heterodera glycines influenced by Diaporthe phaseolorum var. caulivora and defoliation by Pseudoplusia includens.

23.046 CRIS0134352
INTERACTIONS AMONG MEMBERS OF A PEST COMPLEX AND THEIR INDIVIDUAL AND COMBINED EFFECTS ON DEVELOPMENT

BOETHEL D J; RUSSIN J S; LAYTON M B;
Entomology; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02682 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 90

Objectives: To determine the impact of a pest complex (insect-fungus nematode) on soybean development and yield. To determine the incidence and severity of a stem pathogen as affected by stress from a nematode infection and two types of insect damage (stem girdling and defoliation). To determine the effects on nematode population development of stress from two types of insect damage (stem girdling and defoliation).

Approach: The impact of a pest complex (defoliating insect-canker fungus-nematode) on soybean development and yield will be determined using field microplots. This will allow development and maturation of plants and manipulation of pest species under natural conditions. Incidence and severity of a stem pathogen as affected by stress from a nematode infection and two types of insect damage (stem girdling and defoliation) will be examined under greenhouse conditions using containers sufficiently large to allow development of plants to maturity. Nematode population development will be evaluated on plants stressed by two types of insect damage (stem girdling and defoliation). These experiments will be conducted under greenhouse conditions as described above and, as such, will facilitate frequent sampling necessary to monitor rates of change in populations of cyst nematodes.

23.047* CRIS0078826
ENTOMOPATHOGENS FOR USE IN PEST MANAGEMENT SYSTEMS

FUXA J R; Entomology; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02034 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To identify, characterize and standardize entomopathogens and entomopathogenic formulations to be used in regional trials of efficacy. To determine and analyze the physical and biotic factors that regulate epizootics of entomopathogens. To establish regional procedures and protocols required to maximize the utility of entomopathogens in pest management systems.

Approach: (Obj. 1) Isolates of Spodoptera frugiperda nuclear polyhedrosis virus (NPV) will be bioassayed for virulence and subjected to restriction endonuclease analysis. Repeated passage of virus in host will be used to select for increased virulence. (Obj. 3) Mathematical models will be developed for explanation or prediction of NPV epizootics in S. frugiperda populations. This effort will focus on immigration and resistance to disease and will identify specific questions for experimentation. Dispersion, certain abiotic factors, transmission to host in corn, and effects on populations of young insects will be investigated experimentally. (Obj. 4) Cultural methods will be investigated to enhance prevalence of NPV in S. frugiperda infesting pastures and corn. Sampling will be continued at sites where a Brazilian NPV was released for control of Anticarsia gemmatalis.

Progress: 87/01 to 87/12. The nematode Steinernema feltiae was evaluated as a control agent for fall armyworm (FAW), Spodoptera frugiperda, in field corn. A dose of 10 nematodes/acre resulted in 29% infection, whereas 10 nematodes/acre resulted in only 3% infection. Spray appliation of the nematodes in 60 vs. 30 gal. water/acre did not affect % infection. Treatment with nematodes did not reduce FAW numbers compared to control plots, though results were affected by light FAW populations and a tropical storm. Vertical transmission was studied in FAW nuclear polyhedrosis virus (NPV) in order to improve microbial control. One group of FAW was fed the LD(50) of the Louisiana NPV, and another the LD(50) of a Puerto Rican isolate. The survivors were reared to the adult stage and mated. The next generation of FAW exposed to the Louisiana isolate had no infected insects, but 1% of the Puerto Rico group were killed by NPV. A subsequent experiment had 3 experimental groups: 1. FAW exposed to a dose of NPV slightly higher than the LD(50); 2. FAW again exposed to the LD(50) of the Puerto Rican isolate; and 3. the same treatment as group 2, except that the eggs of the mated survivors were washed in NaC10 solution. In the F(1) generation, infection rates were 0.4% in Group 1, 1.1% in Group 2, and 0.4% in Group 3. Percentages of infection were based on a total of 6,853 FAW in the 2 experiments; thus, confidence in vertical transmission as a real phenomenon is increasing in spite of the low percentages.

Publications: 87/01 to 87/12

FUXA, J.R. 1987. Ecological considerations for the use of entomopathogens in IPM. Annu. Rev. Entomol. 32:225-251.

FUXA, J.R. and TANADA, Y. (Eds.). 1987. Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. 555 pp.

FUXA, J.R. and TANADA, Y. 1987. Epidemiological concepts applied to insect epizootiology. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 3-21.

FUXA, J.R. 1987. Epidemiological concepts applied to insect epizootiology. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 23-41.

TANADA, Y. and FUXA, J.R. 1987. The pathogen population. In J.R. Fuxa and Y. Tanada (Eds.), Epizootiology of Insect Diseases. John Wiley and Sons, Inc. N.Y. pp. 113-157.

DAIGLE, C.J., BOETHEL, D.J. and FUXA, J.R. 1987. Parasitoids and pathogens of green cloverworm (Lepidoptera: Noctuidae) on an

unclutivated spring host (Vicia spp.) and a cultivated summer host (soybean, Glycine max (L.) Merrill).

FUXA, J.R. and YEARIAN, W.C. 1987. Viruses. In C.W. McCoy (Gen. Ed.), Microbial Agents for Use in Integrated Pest Management Systems. An Overview Emphasizing Research Accomplishments for Regional Project S-135, 1978 to 1983.

23.048* CRIS0131303
IDENTIFICATION, BIOLOGY, AND MANAGEMENT OF AGRICULTURALLY IMPORTANT PLANT PARASITIC NEMATODES

MCGAWLEY E C; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02587 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 SEP 91

Objectives: To identify nematode genera, species, and races parasitic on major Louisiana crop plants. To evaluate the influence of other major plant pest groups on nematode population ecology and pathogenicity. To investigate methods useful in reducing nematode-related plant injury.

Approach: Nematode survey, greenhouse host differential testing for nematode race identification, light microscopy of nematode and plant characteristics. Field plot experiments, microplot research. Laboratory, greenhouse, and field experimentation with natural and synthetic nematicides.

Progress: 87/01 to 87/12. In numerical order, with the frequency of detection indicated in parentheses immediately after, the distribution of the five known races of the Soybean Cyst Nematode (as represented by 162 soil samples collected from the 13 major soybean producing parishes) in Louisiana is as follows: race 1 (7); race 2 (24); race 3 (68); race 4 (30); race 5 (15) and, questionable race (18). Results of greenhouse studies conducted to assess the interaction or lack thereof between the Soybean Cyst Nematode and the Red Crown Rot disease pathogen, Calonectria crotalariae, indicates that the reproduction f each organism is augmented in the presence of the other. Disease effects are additive. Penetrsation of root tissues of cyst nematode resistant plants is significantly increased when it is infected with the fungus. Race 2 of Meloidogyne incognita (Mi-2) is the most common one associated with soybeans in Louisiana. Cultivars which contain resistance to this nematode are available. Cultivars with resistance to Mi-2, but which are severely galled have been observed under field conditions with increasing frequency during the last two years. These cultivars contain both Mi-2 and M. iavanica.

Publications: 87/01 to 87/12

OVERSTREET, C. and MCGAWLEY, E.C. 1987. Influence of Calonectria crotalariae on reproduction of Heterodera glycines on resistant and susceptible soybeans. Journal of Nematology. (In press).

RUSSIN, J.S., LAYTON, M.B., BOETHEL, D.J., MCGAWLEY, E.C. SNOW, J.P. and BERGGREN, G.T. 1987. Interactions of Heterodera glycines with Diaporthe phaseolorum var. caulivora and insect-induced defoliation on soybean.

RUSSIN, J.S., LAYTON, M.B., MCGAWLEY, E.C. BOETHEL, D.J. and SNOW, J.P. 1987. Interactions between soybean looper, stem canker fungus, and soybean cust nematode on soybean. Phytopathology 77: (In Press).

LAYTON, M.B., RUSSIN, J.S., MCGAWLEY, BOETHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Effects of insect-induced defoliation, stem canker disease, and soybean cyst nematode on soybean growth and N(2) fixation.

MCGAWLEY, E.C. and WINCHELL, K.L. 1987. Greenhouse reproduction of single and combined Meloidogyne incognita and M. javanica on soybean. Journal of Nematology 19: (In Press).

23.049 CRIS0132009
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

MCGAWLEY E C; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02608 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: Nematode species and races which occur in crops grown in rotation with soybeans will be monitored and reported using standard procedures. The interaction of soybean germplasm resistance and nematode virulence will be determined among cultivars and advanced breeding lines. Hatch, migration, penetration, establishment and maturation rates of nematodes will be determined for soybean cultivars.

Progress: 87/01 to 87/12. Results of a survey of nematodes found associated with crops grown in rotation with soybeans indicate that most nematodes, except the soybean cyst nematode, with parasitize soybean also parasitize the cultivars of wheat, corn, and grain sorghum popular in Louisiana. Reciprocally, however, the nematodes Paratichodorus minor and Belonolaimus longicaudatus have been isolated from many wheat, corn, and grain sorghum cultivars and that have not been isolated previously from soybean. Results of a greenhouse race analysis study with Rotylenchulus reniformis indicates that of the two races described and designated a "A" and "B", race "A" is most frequently recovered from soybean, wheat, corn, and grain sorghum. Greenhouse data collected during a series of tests conducted to assess the influence of single and combined populations of the lance nematode, Hoplolaimus geleatus, and the plant parasitic fungi Macrophomina phaseolina and Fusarium sp. on the growth of 'Centennial' soybean indicastes that 1) nematode population levels are indicated increased significantly in the presnce of

Fusarium sp. but not in the presence of M. phaseolina; 2) weights of plants inoculated with a combination of the nematode and each fungus were significantly reduced below those of plants inoculated with each pathogen separately or those left noninoculated as controls.

Publications: 87/01 to 87/12

DABNEY, S.M., MCGAWLEY, E.C., BOETHEL, D.J. and BERNER, D.A. Short term crop rotation systems for soybean production. Accepted-Agronomy Journal, March 1987.

RUSSIN, J.S., LAYTON, M.B., MCGAWLEY, E.C., BOETHEL, D.J., BERGGREN, G.T. and SNOW, J.P. 1987. Impact of an insect/fungus/nematode complex on soybean growth and development.

23.050 CRIS0083737

DETERMINATION OF ECONOMIC THRESHOLDS FOR NEMATODES ASSOCIATED WITH SOYBEAN

MCGAWLEY E C; Plant Pathology & Physiology; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.

Proj. No.: LAB02162 Project Type: STATE
Agency ID: SAES Period: 01 MAR 81 to 31 DEC 86

Objectives: To identify genera of phytoparasitic nematodes associated with La. soybean varieties. To monitor the population dynamics of nematodes commonly associated with La. soybean varieties. To establish "damage thresholds" for nematodes of economic importance to the La. soybean industry.

Approach: Collection of soil samples from soybean fields and subsequent extraction and identification of plant parasitic species. Greenhouse studies in which soybean plants are inoculated with monoxenic nematode cultures to evaluate their susceptibility to damage and their suitability as hosts. Fumigation and infestation of experimental microplots with mixed nematode populations representing the genera and proportions commonly found under field conditions.

Progress: 81/03 to 86/12. Field, greenhouse, and laboratory data collected during the tenure of this project indicate that phytoparasitic nematodes constitute a significant threat to the production of soybeans, and probably most other annual crops, in Louisiana. On soybean, 18 nematode genera (which includes some 33 species - 4 of which are presently undescribed) are commonly associated with many of the cultivars popular in Louisiana. Among these genera, the soybean cyst (SC), root-knot (RK), and reniform (RR) nematodes are, individually, the most damaging. Species and races of SC, RK, and RR have been identified using a prescribed set of host-differentials. For SC a total of 5 races have been identified with frequencies of 62% race 3, 17% race 2, 14% race 4, 5% race 5, and 2% race 1; for RK 2 species, M. incognita and M. javanica have been identified and 98% are race 2 of M incognita; for RR only race B has been identified. Soybean damage thresholds for SC, RK, RR, and stunt nematodes are 100 cysts, 1,000 juveniles, 500-750 individuals, and 2,000 individuals per 500 cubic centimeters of soil, respectively. The damage threshold for lesion nematodes endoparasitic on soybean, is 25 individuals per gram of fresh root tissue. Yield increases for TemikR, NemacurR, and FuradanR (3 nematicides recommended for use on soybeans in Louisiana) over a period of 4 years and at a one pound active ingredient per acre rate averaged 8.8, 4.2, and 2.7 bushels per acre above those of non-treated controls.

Publications: 81/03 to 86/12

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McGAWLEY, E.C. and CHAPMAN, R.A. 1983. Population development of concomitant Criconemoides simile, Helicotylenchus pseudorobustus, and Paratylenchus projectus on soybean. Journal of Nematology 15(1):87-91.

MCGAWLEY, E.C., BERGGREN, G.T. and WINCHELL, K.L. 1983. Economic threshold research with nematodes parasitic on soybean in Louisiana. Abstracts of Papers, 4th International Congress of Plant Patnology, p. 148 589.

MCGAWLEY, E.C., BERGGREN, G.T. and WINCHELL, K.L. 1983. Research on the effects of ectoparasitic nematodes on soybean yields. Proc. Southern Soybean Disease Workers, p. 29.

MCGAWLEY, E.C., RUSH, M.C. and HOLLIS, J.P. 1984. The Occurrence of Aphelenchoides besseyi in Louisiana rice seed and its interaction with Sclerotium oryzae in selected cultivars. Journal of Nematology 16(1): 42-46.

MCGAWLEY, E.C., WINCHELL, K.L., BERGGREN, G.T., MARSHALL, J.G., DABNEY, S.M., GERSHEY, J.S., PACE, M.E. and YANES, J. 1985. Nematode influence on soybean production in Louisiana. Louisiana Agriculture 29 (10)12-16.

23.051 0143918

NATURAL BIOREGULATORS & ANALOGS OF PLANT PARASITIC NEMATODES-NEW ENVIRONMENTALLY SAFE NEMATICIDES

HUETTEL R N; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-065-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 89 to 31 MAR 90

Objectives: 1) Determine effects of pheromones and analogs of soybean cyst nematode under greenhouse and field conditions; 2) isolate sex and other pheromones from other bisexual cyst nematodes; 3) develop bioassays to understand pheromones that effect sex change in parthonogenetic nematodes.

Approach: Develop and improve bioassays for detection of pheromones, utilize control release formulations, such as alginated pellets for application of pheromone and analogs to

greenhouse and field, use in vitro tissue culture techniques to develop bioassays to test for sex change pheromones.

Progress: 89/10 to 89/12. A patent was completed, approved by the USDA Patent Committee and is in the process of being filed on the soybean cyst nematode sex pheromone and thirteen of its analogs. Greenhouse studies continued on the use of these compounds in alginated pellet formulations to reduce nematode populations with 6 out of 14 analogs completed. The use of these compounds may provide new environmentally safe compounds for commericial use to control soybean cyst nematodes. A study on the affect of root-knot nematodes on scion cultivars of peach propagated in vitro, the greenhouse and in microplots was completed. The results indicated that the response of peaches to nematodes at five weeks in vitro is the same as observed for in vitro propagated peaches grown in the greenhouse and under field conditions. The cultivar "Compact Red Haven" appeared to have the best level of nematode tolerance and will be tested in other locations. In vitro growth studies on Pastueria spp. continued. Monoclonal and polyclonal antibodies were developed in cooperation with Rutgers University. New cultivation techniques look very promising. Field plots were established in 1988 and 1989 in an area infested with soybean cyst nematodes that had been used to evaluate resistant soybean germplasm the previous season. A high degree of population spatial heterogeneity is desirable for developing computer models for promotion of alternative control strategies and this was verified both years.

Publications: 89/10 to 89/12

HUETTEL, R.N. 1989. In vitro screening of soybean cultivars to Radopholus similis and R. citrophilus. Nematropica. In Press. Accepted June, 1989.

HUETTEL, R.N. 1898. Monoxenic culturing of plant parasitic nematodes. IN Plant Parasitic Nematodes. Lab Manual. U. MA Agr. Exp. Sta. Amherst, MA. In Press. Accepted May 1989.

HUETTEL, R.N., REISE, R.W. and HENN, A. 1989. A growers guide to plant parasitic nematodes in Maine. Extension Bulletin, University of Maine. In Press. Accepted June 1989.

HUETTEL, R.N. 1989. Aggregate formation in some Pratylenchus spp. Survival Mechanisms. J. Nematol. 21 566. Abstr.

HUETTEL, R.N. 1989. Response of peach scion cultivars and rootstocks to root-knot nematodes in vitro, in the greenhouse, and in microplots. J. Nematol. 21 566. Abstr.

FRANCL, L.J. and KENWORTHY, W.J. 1989. Heterogeneity in population density of soybean cyst nematodes after evaluation of soybean germplasm. J. Nematol. 21 561. Abstr.

23.052 0144454

BIOCONTROL OF PLANT PARASITIC NEMATODES TO REDUCE GROUND WATER CONTAMINATION FROM NEMATICIDES

MEYER S L F; HUETTEL R N; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-13240-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 FEB 89 to 01 FEB 94

Objectives: (1) Identify, isolate, and characterize fungi that are antagonistic to the soybean cyst nematode (SCN). (2) Develop SCN-antagonistic fungi for biocontrol of the SCN by enhancing their virulence, fungicide tolerance, and environmental stability. (3) Evaluate effectiveness of SCN-antagonistic fungi to control the SCN.

Approach: Fungi will be tested for antagonism to soybean cyst nematode. Genetically manipulated strains (mutants induced by ultraviolet light or chemicals) will be evaluated in greenhouse and field plots, along with wild type strains, to determine which fungi are effective against soybean cyst nematode in the soil.

Progress: 89/02 to 89/12. A strain of fungus antagonistic to the soybean cyst nematode was evaluated in greenhouse studies for ability to act as a biological control agent against this nematode in the soil. These studies supplied information on optimal application rates of fungal inoculum and on ability of the fungus to act when applied at planting and as a postplant pesticide. Methods for production of fungal inoculum were improved and new procedures were developed to expedite production of alginated pellets containing the fungal matter. Alginated pellets are used to deliver the fungal inoculum to the soil. Pellets up to one year old were found to contain viable fungal inoculum, indicating that this delivery system may prove useful in commercial applications. Strains of fungi that exhibited increased tolerance to the fungicide benomyl were grown without benomyl present and then studied to determine whether the increased benomyl tolerance persisted. Such tolerance may increase the ability of a fungus to act as biocontrol agent when benomyl is applied as part of an integrated pest management system. Two strains of fungi were also tested in the laboratory for antagonism to the root knot nematode Meloidogyne incognita. An "Invention Reporting and Invention Ownership Form" was approved by the Patent Committee for Biotechnology in June 1989. This research is directed toward finding alternatives to chemical nematicides that have contributed to groundwater contamination.

Publications: 89/02 to 89/12

NO PUBLICATIONS REPORTED THIS PERIOD.

23.053 CRIS0049511
HOST-PARASITE RELATIONS OF CYST AND ROOT-KNOT NEMATODES ON SUSCEPTIBLE & RESISTANT CROP PLANTS

ENDO B Y; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-027-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 MAY 85 to 01 MAY 90

Objectives: Determine the 1) ultrastructure of the esophageal region of early develop- mental stages of the soybean cyst nematode (SCN); 2) structure and functionof hypodermal tissue; 3) interaction between esophageal glands and feeding apparatus; and 4) in vivo host response to feeding.

Approach: Electron micrographs will be made of the stylet regeneration of 3- to 6-dayold infective larvae of SCN to determine the regeneration of new stylets during molt. The ultrastructure of the hypodermis will be observed to determine its role in cuticle separation and regeneration during molt. These projects will integrate the newly discovered concepts of Tylenchid stylet regeneration to that of the hypodermis related molting process. Host-parasite interactions at the ultrastructural level should provide clues as to the sequence of changes that occur in host cells of susceptibleand resistant cultivars during feeding and growth of the SCN. Video-enhanced imaging of light microscope observations will be supported by previous and current ultrastructural data of nematodes and their host responses. These data of enhanced images will permit observations of organelle movements that may provide clues to a greater understanding of host-parasite interactions and their disruption in nematode control pro-grams.

Progress: 87/01 to 87/12. Research was conducted on the ultrastructure of the infective and parasitic stages of the soybean cyst nematode, Heterodera glycines, with emphasis on the esophageo-intestinal and intestino-rectal valve as related to food ingestion, digestion, and expulsion. The presence of microvilli-like membrane folds and distinctive enteric coating materials of surface membranes in the intestinal lumen of various stages of the nematode was observed. The lumen was partially blocked by the dense accumulation of the microvilli-like membrane folds after feeding commenced. Noncuticularized membranes of apical surfaces of cells of the esophageo-intestinal and intestino-rectal valves regulate the passage of ingested food and expulsion of waste products. Junctional complexes occurred between the lateral membranes of cells forming the esophageo-intestinal valve, the intestinal epithelium, and the intestino-rectal valve. Muscle fibers were associated with the intestino-rectal valve. Current research focused on the ultrastructure of the esophagus of the root-knot nematode, Meloidogyne incognita. The research has provided new fundamental information on nematode morphology and host-parasite relations. This information will be useful to plant pathologists and others in the search for alternate methods for controlling nematodes.

Publications: 87/01 to 87/12
ENDO, B.Y. 1987. Histopathology and ultrastructure of crops invaded by certain sedentary endoparasitic nematodes, In: Vistas on Nematology. J. Veech and D. Dickson (eds). E.O. Painter Printer Co. DeLeon Springs, Florida. 196-210.
ENDO, B.Y. 1987. Ultrastructure of esophageal gland secretory granules in juveniles of Heterodera glycines. J. Nematol. 19:520. (Abstract).
ENDO, B.Y. 1987. Ultrastructure of esophageal secretory granules in juveniles of Heterodera glycines. J. Nematol. 19:469-483.

23.054* CRIS0049448
PHEROMONES AND NATURAL BEHAVIOR MODIFYING CHEMICAL COMMUNICATORS OF HELMINTHS OF PLANTS

HUETTEL R N; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-028-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 84 to 30 SEP 89

Objectives: To study plant parasitic nematode behavior and observe, isolate and identify natural nematode metabolites and behavior modifying compounds (semiochemicals) that may be used to develop new, safer nematode control and bioregulation strategies.

Approach: Develop and improve xenic cultures of plant parasitic nematodes (particu- larly races of soybean cyst, Heterodera glycines; H. schachtii, sugarbeet cyst; H. zeae, corn cyst; Meloidogyne spp; root knot; Rotylenchulus reniformis, reniform; and Pratylenchus spp. lesion nematodes) to observe their development, behavior responses and reaction to pheromones and other semiochemicals. Develop and improve bioassay methods for the detection, isolation, purification and evaluation of specific pheromones and semio- chemicals. Usechromatographic (HPLC, TLC), electrophoretic (SDS, isoelec- tric focusing), and histochemical techniques to isolate and purify new semiochemicals for chemicalcharacterization and to identify their synthesisand receptor sites. Compare similarities and differences of specific pheromones and metabolites of races and species cyst nematodes.

Progress: 87/01 to 87/12. A new in vitro screening technique was developed for determining the pathogenicity of migratory plant parasitic nematodes (PPN) to 15 soybean cultivars. Cultivars known to be resistant to cyst and root-knot nematodes (RN) were highly susceptible to PPN, burrowing nematode. Greenhouse and second year field studies of peach propagated from tissue culture show that the in vitro screening of peach to RN at five weeks gives the same results as two years in the field. The results of both these studies will be of value to breeders and researchers

for developing new plant varieties. Digestion profiles of total DNA from three races of soybean cyst nematodes (SCN) by eight restriction enzymes were analyzed on agarose gels. The DNA fragment patterns generated by the three races appeared to be of diagnostic importance. A new technique for rapid DNA isolation was described. These studies aid in understanding the systematics of races of SCN and may lead to production of diagnostic kits for industry. Identification of the sex attractant of SCN has been verified by regrowth of SCN on root-explant in ultrapure water. Purification and identification was completed on GC-MS. The use of pheromones as bioregulators may provide industry with new approaches to nematode management.

Publications: 87/01 to 87/12

HUETTEL, R.N. 1987. In vitro screening of Radopholus citrophilus and R. similis to soybean cultivars. J. Nematol. 18:529. (Abstract)

HUETTEL, R.N., and JAFFE, H. 1987. Attraction and Behavior of Heterodera glycines, the soybean cyst nematode, to some biological and inorganic compounds. Proc. Helminthol. Soc. Wash. 54:122-125.

HUETTEL, R.N., and YAEGASHI, T. 1987. Morphological differences between Radopholus citrophilus and R. similis. Accepted by the J. Nematol. 9-15-87.

REISE, R.W., HUETTEL, R.N., and SAYRE, R.M. 1987. Carrot callus tissue for culture of endoparasitic nematodes. J. Nematol. 19:387-389.

KALINSKI, A., and HUETTEL, R.N. 1987. Repetitive fragments comparison as a diagnostic assay in detection of races of soybean cyst nematode, Heterodera glycines. Accepted by the J. Nematol. 12-20-87.

23.055 CRIS0048290

ACQUISITION AND EVALUATION OF SOYBEAN GERMPLASM MATURITY GROUPS V THROUGH X

KILEN T C; HARTWIG E E; Agricultural Research Service, Stoneville, **MISSISSIPPI** 38776.
Proj. No.: 6402-21000-003-00D
Project Type: INHOUSE
Agency ID: ARS Period: 18 APR 83 to 18 APR 88

Objectives: To systematically acquire, evaluate, and distribute soybean (Glycine max and G. soja) germplasm; to identify and evaluate traits with potential merit for improvement of seed quality, plant structure, and pest protection; and to develop an appropriate data base for all accessions.

Approach: Acquire, through plant exploration or by exchange between countries, new soybean germplasm accessions of maturity groups V through X, adapted to latitudes 37 degrees or less. Employ novel propagation techniques and grow-out procedures to overcome problems of low viability, reduced vigor, procumbent growth habit, and early pod-dehiscence prevalent in primitive accessions. Identify and evaluate anatomical and physiological traits, pest and herbicide reactions, and chemical composition of seed. Document all characteristics having potential for germplasm enhancement and for increasing genetic diversity. Build an efficient, useful data base as part of the Germplasm Resources Information Network.

Progress: 87/01 to 87/12. A systematic evaluation of soybean germplasm (maturity groups V through X) for resistance to insects, nematodes, and diseases was initiated. Several accessions from the soybean germplasm collection were evaluated in 1987 for resistance to insects (soybean looper, 1550 accessions in maturity group V) and for resistance to the soybean cyst nematode races 3, 4, and 5 (578 accessions not previously evaluated). Three hundred and twenty maturity group V germplasm lines were inoculated and evaluated for resistance to the stem canker disease. Of these, 188 (58%) were resistant. One hundred and forty-two maturity group VI to X germplasm lines that were rated resistant to stem canker in 1986 were evaluated for resistance to naturally occurring Rhizoctonia web blight and frogeye in observation plots planted near Hattiesburg, MS. On a scale of 0 to 5, 20 lines were resistant with a rating of 1, and 75 lines received a rating of 2. Fifty-two lines (36%) appeared immune to the races of frogeye present where the nursery was grown. Germplasm lines classified pest-resistant will be evaluated in a second environment before data are entered into the GRIN system.

Publications: 87/01 to 87/12

MCKENNA, T., LAMBERT, L., OUZTS, J. and KILEN, T. 1987. Field cage evaluation of wild soybean, Glycine soja (Sieb. and Zucc.) for resistance to three lepidopterous defoliators. Proc., Miss. Entomological Assoc. Vol. V:53-55.

23.056 CRIS0140444

PRODUCTION SYSTEMS AND WATER MANAGEMENT FOR SOYBEANS IN THE LOWER MISSISSIPPI VALLEY

HEATHERLY L G; Soybean Production Research Unit; Agricultural Research Service, Stoneville, **MISSISSIPPI** 38776.
Proj. No.: 6402-13230-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Development management systems for limited tillage of soybeans planted on clayey soils; determine effective and profitable irrigation management schemes for soybean production; and evaluate cropping systems that include soybeans for improved resource conservation and enhanced profit potential.

Approach: Develop crop rotational production systems that utilize available water most efficiently and that enhance and sustain profit potential; determine long-term effects of using limited tillage concept for planting soybeans onclay soil, and develop management systems to be used in this scheme that will enhance profit potential; evaluate management systems for efficient use of irrigation of soybeans to enhance and stabilize yields and profits; and assess irrigation and water management

practices for use in the presence of soybean cyst nematodes and pod-feeding insects.

Progress: 87/01 to 87/12. Planting soybean in variously tilled Sharkey clay seedbeds resulted in comparable yields among treatments planted in early May (2899 kg/ha) and early June (2518 kg/ha), and irrigated. Flood irrigation of Centennial and Sharkey soybean resulted in significant yield increases of 1507 and 1927 kg/ha, respectively, but lengthening the flood period from 2 to 3 days reduced yield response. Irrigation of monocrop corn, sorghum, and soybean grown on clay soil resulted in significant yield increases for soybean (3065 vs. 1401 kg/ha), but only slight increases for corn (7513 vs. 6003 kg/ha) and sorghum (7400 vs. 6665 kg/ha). Irrigated and nonirrigated soybean produced significantly greater yields when following corn or sorghum vs. following soybean. Method of grass weed control in irrigated soybean grown on clay soil had no significant effect on seed yield in the fourth year of a study. Method of burnback chemical weed control at planting resulted in varying levels of weed presence at harvest, but had no significant effect on soybean yield. Irrigation of weed-free soybean resulted in a seed yield (2782 kg/ha) that was 317 kg/ha greater than that from an irrigated, weed-infested stand. Level of weed infestation had no significant effect on seed yield in a nonirrigated environment. Soybean planted in 18 and 51-cm wide rows produced significantly more seed than when planted in 76 and 102-cm wide rows on a silt loam soil. The earlier-maturing A 5474 cultivar yielded significantly more than Leflore in all row spacings.

Publications: 87/01 to 87/12

HEATHERLY, L.G., WESLEY, R.A., and ELMORE, C.D. 1986. Irrigation effects on corn, sorghum, and soybean grown on clay soil. Agron. Abstracts. p. 113. (Abstr.)

HEATHERLY, L.G., and PRINGLE, H.C., III. 1987. Flood irrigation of soybean grown on clay soil. Annual meeting, Southern Br., Amer. Soc. Agron. P. 7. Abstract.

ELMORE, C.D., and HEATHERLY, L.G. 1987. Seedbed preparation effects on weeds in soybean on clay soil. Southern Weed Sci. Soc. Proc. 40:302. (Abstr.).

HEATHERLY, L.G., and PRINGLE, H.C., III. 1987. Flood irrigationn of soybean grown on clay soil. Proc., Delta Irrigation Seminar, Greenwood, MS. Feb. 18, 1987. MS Coop. Ext. Serv., Starkville, MS. pp. 11-18.

PENNINGTON, D.A., and HEATHERLY, L.G. 1987. Effects of changing solar radiation on cotton and soybean canopy temperature. Proc., Beltwide Cotton Prod. Res. Conf. pp. 86-89.

23.057 CRIS0084276

EVALUATION OF NEMATICIDES FOR POPULATION MANAGEMENT OF PLANT PARASITIC NEMATODES ASSOC. WITH SOYBEAN

MCGUIRE J M; BOST S C; BUEHRING N; Plant Pathology & Weed Science; Mississippi State University, Mississippi State, **MISSISSIPPI** 39762.

Proj. No.: MIS-2343 Project Type: STATE
Agency ID: SAES Period: 01 JAN 81 to 31 DEC 86

Objectives: Evaluation of nematicides for the population management of plant parasitie nematodes associated with soybean to improve yields.

Approach: Establish field trial which will include randomized, replicated plots to study nematicide efficacy, rates, and application techniques.

Progress: 86/01 to 86/12. Population development of the namatodes Pratylenchus, Helicotylenchus, Criconemella, Tylenchorhynchus, Trichodorus, Scutellonema, Xiphinema, and Quinisulcius acutus was determined in soil treated with Temik and cropped with Jeff soybean. The test was located in a field previously cropped with grain sorghum, and had initial nematode densities of 93 to 260 nematodes/500 cm of soil. Temik was applied at 0, 11.1, 16.8, and 22.2 kg formulated material/hectare then incorporated into the top 5 cm of soil. The differences in Pi among treatments were not significant. All populations were lower 32 days after nematicide application. The highest nematicide treatment had the lowest nematode population for 131 days after nematicide application. A reproduction factor of 1.2, 7.0, 6.9 and 1.8 was recorded from the 0, 11.1, 16.8 and 22.2 kg/hectare treatments respectively. No differences in yield were recorded among treatments.

Publications: 86/01 to 86/12

NO PUBLICATIONS REPORTED THIS PERIOD.

23.058 CRIS0130783

NEMATODE COMMUNITIES ASSOCIATED WITH SOYBEANS AND THE CONTROL OF PATHOGENIC SPECIES

MCGUIRE J M; LAWRENCE G W; Plant Pathology & Weed Science; Mississippi State University, Mississippi State, **MISSISSIPPI** 39762.

Proj. No.: MIS-2359 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 31 DEC 91

Objectives: Cropping sequences utilizing host resistance to manage soybean cyst nematode (SCN); multiple cropping sequences to discourage SCN race development; identify and establish pathogenicity of nematodes associated with soybean; characterize fungi associated with SCN and determine their pathogenicity and effects.

Approach: Establish long term cropping sequences utilizing SCN-resistant and susceptible soybean cultivars and crops not reproductive hosts of SCN in rotation sequences. Measure population density and race composition periodically. Sample soil from soybean fields and identify microscopically. Determine pathogenicity and effect on soybean in greenhouse and microplots. Determine fungi associated with cysts and eggs of SCN in suppressive soils and determine pathogenicity in genotobiotic and agnotibiotic culture, utilizing microscopy.

Progress: 87/01 to 87/12. The polyspecific nematode populations associated with soybeans were comprised of ten genera of plant parasitic nematodes. These include Heterodera glycines, Helicotylenchus, Meloidogyne arenaria, Meloidogyne incognita, Paratylenchus, Pratylenchus, Quinisulcius acutus, Scutellonema, Trichodorus, Tylenchorhynchus, and Xiphinema. Homogeneous nematode populations are currently being increased in the greenhouse for pathogenicity test and species identification. Soil was collected from soybean fields in which the SCN populations have not increased to high levels under continuous cropping with susceptible soybean cultivars. Mature cysts were extracted from soil, quantified, surface sterilized, then plated aseptically on potato dextrose agar amended with 100 mu/ml of streptomycin. An average of 55% of the cysts were colonized by fungi. Twelve species of fungi have tentatively been identified from these cysts. Fusarium solani (28% of cysts) and Neottiosporina anoda (Stagonospora?) (17% of cysts) were the fungi most frequently isolated from cysts. The ability of these fungi to recolonize cysts was examined in culture on water agar plates and in infested soil. In culture, 37 and 58 percent of the cysts were colonized by F. solani and N. anoda, respectively. In soil infested with the two fungi, 64 percent of the cysts were colonized by F solani and 49% with N. anoda.

Publications: 87/01 to 87/12

LAWRENCE, G.W. 1986. Population development of plant parasitic nematode communities on Tracy-M soybeans and the association of nematophagus fungi with the soybean cyst nematode. Northeast Mississippi Research Progress Report Information.

23.059 CRIS0131314

BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEANS

MCGUIRE J M; LAWRENCE G W; Plant Pathology & Weed Science; Mississippi State University, Mississippi State, **MISSISSIPPI** 39762.
Proj. No.: MIS-2360 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation. To develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: Long term cropping sequences utilizing resistant cultivars, susceptible cultivars and crops which are non-host to SCN will be established. Reproduction indices and race identification test will be conducted annually to determine race shifts. Selected resistant soybean germplasm will be inoculated with SCN populations. Population densities and reproductive indices will be used to determine virulence. SCN collected from suppressive fields, non-suppressive fields, and fields subjected to various rotation sequences will be examined for fungal colonization. Fungal associations will be determined in gnotobiotic and agnotobiotic culture utilizing microscopic examination.

Progress: 87/01 to 87/12. Eleven rotation sequences were established in a field infested with a race 3 population of the soybean cyst nematode (SCN). Rotation sequences consist of a continuous SCN-susceptible cultivar, race 3-resistant cultivar, race 3 and 4-resistant cultivar, sequences of susceptible and resistant cultivars and non host or fallow treatments. The race status of the populations from each sequence was characterized by planting SCN race differentials into pooled soil samples from all replications of each treatment. Populations from five of the rotation sequences were identified as race 3. The populations from the remaining six rotations reproduced greater than 10% on the differential Pickett, therefore, these were considered undescribed races. The use of continuous race 3-resistant cultivars appears to have caused increased virulence to these cultivars. In contrast, the use of the susceptible cultivars in the rotation appears to have reduced the tendency for virulence changes.

Publications: 87/01 to 87/12

LAWRENCE, G.W. and MCGUIRE, J.M. 1987. Influence of soybean cultivar rotation sequences on race development of Heterodera glycines, race 3 (Abstr.). Phytopathology (In Press).
LAWRENCE, G.W., MCGUIRE, J.M. and BOST, S.C. 1987. Impact of rotation sequences upon race development of the soybean cyst nematode and yield responses. (Abstr.). MAPPAN Proceesings (In Press).

23.060 CRIS0057057

SOYBEAN BREEDING AND IMPROVEMENT IN MISSOURI

ANAND S C; Agronomy; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00359 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 85 to 30 JUN 90

Objectives: To develop superior soybean varieties adapted to various environments in Missouri; to breed cultivars resistant to prevalent races of cyst nematodes and other common diseases of soybeans; to evolve breeding techniques for varietal improvement, and to develop soybean varieties for double cropping.

Approach: Collect soybean germplasm from diverse origin; screen and isolate strains resistant to various diseases, pests and superior agronomic traits; study the mode of inheritance of disease resistance and yield components which would help in selection; make crosses between soybean strains to combine desirable characters from different sources, screen and select in the segregating generations and evaluate the newly developed lines both for normal planting and double cropping.

Progress: 87/01 to 87/12. 'Avery', a new soybean (Glycine max L.) cultivar was released to the growers. Avery was developed at the

Delta Center, Portageville, MO. by the Missouri Agricultural Experiment Station, and simultaneously released by Missouri, Maryland, and Virginia Agricultural Experiment Stations and the U.S. Department of Agriculture. Avery was developed from the cross Bedford x Crawford. Bedford is a maturity group V determinate cultivar with resistance to races 3 & 4 of the soybean cyst nematode (SCN). Crawford is an indeterminate cultivar in maturity group IV. Avery was developed by pedigree method and the progeny of an F(5) plant was bulked for initial yield evaluation. The F(3) and F(4) single plants were screened in the greenhouse against cyst nematode races 3 & 4 for selecting resistant plants. Avery was identified as S79-4259 prior to its release, and was yield tested in the USDA Uniform soybean tests IV south from 1982-1985 and in cooperative SCN tests from 1984-1986. Avery yielded as good or better than Douglas and Pershing in the Uniform tests and significantly superior over Douglas, Sparks, Egyptian and Franklin in SCN tests. Avery is an indeterminate cultivar and is 7-8 days later than Douglas. It has white flowers and tawny pubescence. It is resistant to soybean cyst nematode, Heterodera glycines, Ichinohe and moderately resistant to root knot nematode, Meloidogyne incognita. The foundation seed of Avery will be maintained by the Missouri Agricultural Experiment Station.

Publications: 87/01 to 87/12

FREYTAG, A.H., ANAND, S.C., RAO-ARELLI, A.P. and OWENS, L.D. 1987. A rapid method of regeneration of Beta vulgaris L. in vitro. Plant Cell Reports (In Press).

ANAND, S.C. and FICHTER, P.M. 1987. Avery: A new soybean variety for double cropping. Field Day Report 1987. Univ. Missouri, Delta Center DC 2:11-13.

RAO-ARELLI, A.P., and ANAND, S.C. 1987. An improved greenhouse method of evaluation for inheritance of resistance to race 4 of soybean cyst nematode. Soybean Genet. Newsletter 14:237-239.

RAO-ARELLI, A.P. and ANAND, S.C. 1987. Genetics of resistance to race of soybean cyst nematode in soybean plant introduction. 1986 Soybean Report. Agronomy Series 7. University of Missouri-Columbia. p. 1.

FREYTAG, A.H., ANAND, S.C., RAO-ARELLI, A.P. and OWENS, L.D. 1987. Media optimization for rapid regeneration of sugarbeets (Beta vulgaris L.) in vitro. Agron. Abstr. p. 149.

23.061 CRIS0135862

STRATEGIES TO CONTROL HETERODERA GLYCINES LOSSES IN SOYBEANS

ANAND S C; NIBLACK T L; Agronomy; University of Missouri, Columbia, **MISSOURI** 65211.

Proj. No.: MO-00359-6

Project Type: SPECIAL GRANT

Agency ID: CSRS Period: 15 JUL 88 to 31 JUL 91

Objectives: To study the relationship between time of infection with Heterodera glycines and soybean yield; to examine the interaction between Heterodera glycines and Fusarium solani on soybeans for investigating the etiology of sudden death syndrome; and to attempt transformation of soybeans by using Agrobacterium tumefaciens.

Approach: The time of infection with Heterodera glycines on soybeans will be studied under field conditions by using nematicide to delay the infection; the interaction between Heterodera glycines and Fusarium solani will be examined both under natural infestation in the field and by artificial inoculation under greenhouse conditions; and transformation of soybean will be attempted by using a disarmed tumor-inducing plasmid in A. tumefaciens.

23.062 0137827

GENETIC DIVERSITY IN SOYBEANS FOR RESISTANCE AND TOLERANCE TO HETERODERA GLYCINES

ANAND S C; NIBLACK T L; Agronomy; University of Missouri, Columbia, **MISSOURI** 65211.

Proj. No.: MO-00359-7

Project Type: SPECIAL GRANT

Agency ID: CSRS Period: 01 APR 89 to 31 MAR 92

Objectives: To study genetic relationships among soybean plant introductions for resistance to Heterodera glycines; to determine the effect of continuous culture of resistant soybean varieties on gene frequencies in cyst nematode, and to study root growth and rhizosphere characteristics in soybeans in response to cyst nematode infection.

Approach: Resistant soybean plant introductions will be crossed with each other and their progenies will be studied for segregation for cyst nematode reaction; the effect of continuous culture will be determined by studying the gene frequencies in cyst nematode each year after planting a resistant soybean variety in the field, and the soybean root response will be studied in resistant, susceptible and tolerant soybeans after inoculation with cyst nematode.

23.063 CRIS0093112

GENETIC AND ENVIRONMENTAL STUDIES TO CONTROL SOYBEAN CYST NEMATODE LOSSES

ANAND S C; WRATHER J A; Agronomy; University of Missouri, Columbia, **MISSOURI** 65211.

Proj. No.: MO-00359-3

Project Type: SPECIAL GRANT

Agency ID: CSRS Period: 01 JUN 84 to 31 MAY 89

Objectives: To determine the relationship between the preplant soil populations of soybean cyst nematodes and yield losses in soybeans; to transfer cyst nematode resistance from diverse sources to an agronomically superior soybean background; to study the effect of continuous use of resistant soybean varieties on disease epidemic and shift in

genetic makeup in soybean cyst nematode.

Approach: Susceptible soybean cultivar Essex will be planted in the field with different levels of cyst nematode infestation to study disease inoculum at planting time and its effect on yield of the crop. Isogenic lines for cyst nematode resistance will be developed by backcross procedure. The effect of monoculture of soybeans will be studied by examining the race pattern of cyst nematode after each crop season.

Progress: 87/01 to 87/12. To determine the mode of inheritance of resistance for races 3 and 4 of the soybean cyst nematode (SCN), crosses were made between resistant (R) plant introductions (PIs) and susceptible (S) cultivars and PIs of soybeans. The parents, F(2) plants from each cross, and a set of host differentials were screened in the greenhouse under controlled conditions of temperature and light. Each seedling was inoculated with 1000 eggs and juveniles from the homogenous population of a given SCN race. After 30 days, the plant roots were washed to dislodge white females (cysts) and enumerated. Index of parasitism was calculated and used to classify resistant and susceptible plants. Chi-square test was used to determine the goodness of fit between expected and observed ratio based on the number of genes controlling resistance to SCN. The F(2) data from the cross PI 88788(R) x Essex(S) tentatively predicted that two dominant and one recessivegenes conditioned resistance to SCN race 3 in PI 88788(R). Crosses between PI 88788(R) x Peking(S) and PI 88788(R) x Forrest(S) also indicated two dominant and one recessive genes controlling resistance to SCN race 4 in PI 88788(R). The F(3) families are being screened to confirm the results.

Publications: 87/01 to 87/12

ANAND, S.C. and RAD-ARELLI, A.P. 1987. Genetics of resistance to race 5 of soybean cyst nematode in Glycine max (L.) Merr. Agron. Abstr., p. 54.

23.064 CRIS0099703

STUDIES ON DIAPAUSE IN HETERODERA GLYCINES AND GENE EXPRESSION FOR RESISTANCE IN SOYBEANS

ANAND S C; WRATHER J A; Agronomy; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00359-4
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 JUL 86 to 31 JUL 89

Objectives: To study survival and diapause of soybean cyst nematode under different crop rotations; To evaluate gnotobiotic cultures of soybean cyst nematode as means of establishing SCH germplasm; and to study gene expression for cyst nematode resistance.

Approach: Diapause and survival of soybean cyst nematode will be studied in a corn-soybean rotation. Soybean cyst nematode culture will be established on excised roots in petri plates with different media. The effect of light, temperature, and growth regulators will be studied on gene expression for resistance to SCN.

Progress: 87/01 to 87/12. The reproduction of cyst nematode (Heterodera glycines, Ichinohe) was studied at three soil pH levels on soybeans, Glycine max L. The soil pH was adjusted to 5.5, 6.5 and 7.5 by adding appropriate quantities of lime (Calcium hydroxide). The infection of race 3 of soybean cyst nematode (SCN) was tested on 'Essex' a susceptible soybean cultivar, and 'Custer' and 'Bedford', the resistant cultivars. The soybean seedlings ere transplanted in 2.5 cm diam. plastic pots containing sterile soil. One thousand eggs and larvae of SCN race 3 were applied to each pot. The pots were maintained at 27 C+/-1C in the waterbaths. Thirty days after inoculation, the plant roots were washed and the dislodged white females enumerated. The root weight of each plant was also taken. The soil pH had no effect on the root weight of any of the three cultivars. There was no correlation between the root weight and the number of white females per plant. Significant differences were observed between white females per plant at the three pH levels. The number of white females per plant were greater at pH 6.5 than at pH 5.5 and 7.5. No difference were observed between white females per plant for the two resistant cultivars indicating that gene expression for resistance was complete at the three levels of pH.

Publications: 87/01 to 87/12

ND PUBLICATIDNS REPDRTED THIS PERIDD.

23.065 CRIS0131562

THE STUDY OF GENETIC DIVERSITY IN HETERODERA GLYCINES AND INHERITANCE OF RESISTANCE IN SOYBEANS

ANAND S C; WRATHER J A; Agronomy; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MD-00359-5
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 MAY 87 to 30 APR 90

Objectives: To study the genetics of resistance to various races of Heterodera glycines in near-immune soybean line PI 437654 and the homology between resistance genes in different resistant sources; to examine the genetic diversity among isolates of soybean cyst nematode (SCN); and to determine the induction of resistance to SCN with nonpathogenic fungi and nematodes.

Approach: The genetics of SCN resistance and homology in PI 437654 will be studied in the F(2) and F(3) generations of the crosses involving this PI line and other sources of resistance such as PI 88788, PI 90763 and the susceptible Essex. The induction of SCN will be examined by inoculating the susceptible soybean cultivars with nonpathogenic fungi and nematodes and then testing them against pathogenic races of SCN.

Progress: 87/05 to 87/12. Experiments were conducted to determine if soybean could be induced to resist Heterodera glycines infection

by prior inoculation of soybean cotyledons with Colletotrichum lagenarium, a nonpathogen of soybean, or heat-killed C. lagenarium. Susceptible soybean cultivar 'Essex' seedlings were found to resist H. glycines infection when inoculated with C. lagenarium one to five days prior to nematode inoculation. Heat-killed C. lagenarium induced resistance in soybeans when injected into cotyledons five days prior to nematode inoculation, but not when injected into cotyledons one day prior to nematode inoculation. Resistance was evident as a reduction in numbers of swollen J3 and J4 stage juveniles per gram root 14 days after inoculation with H. glycines.

Publications: 87/05 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

23.066 CRIS0097080
GENETICS OF THE CYST NEMATODE-SOYBEAN ASSOCIATION

LUEDDERS V; Agronomy; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00366-1 Project Type: CRGO
Agency ID: CRGO Period: 15 SEP 85 to 31 MAY 89

Objectives: Proj 8501613. To develop the soybean cyst nematode (SCN) inbreds necessary to show single soybean gene effects and to determine the inheritance also of the corresponding SCN genes.

Approach: Genetic Models were developed which explain the variability in cyst numbers on plants by varying numbers of soybean genes for resistance and frequencies of SCN genes. That many susceptible soybeans may have at least one gene for resistance to SCN is supported by results using SCN inbred (by single cyst transfers) and selected on resistant soybean lines (Ilsoy, PI89772 and PI209332). Specific inbreds will be used as base populations to develop inbreds incapable of forming cysts on specific "susceptible" soybeans: drift describes the variance of gene frequencies. SCN inbreds will be crossed after the single soybean gene basis for zero cysts has been established.

Progress: 87/01 to 87/12. Inbreeding along with artificial selection of soybean cyst nematodes produced an inbred that could mature few cysts on the susceptible soybean PI209331. The nematode inbred also formed few females-cysts on the susceptible soybeans AK (Kansas), PI63468, PI87628, PI89783, PI91102, PI437840B, and PI437848A. Segregation of crosses of soybeans indicated at least two genes for resistance in PI 89783 but only one recessive gene in PI88287. Crosses of nematode inbreds indicated a recessive gene for avirulence was interacting with the recessive soybean gene to stop nematode development. These recessive genes affected the number of males as well as females. The inbred developed for few cysts on on PI209331 had few males only on PI88287 and PI437840B, evidence that they had different genes for resistance than the lines with few cysts but many males. Results with several other nematode inbreds and populations indicated that they will help to identify individual soybean genes for resistance, thus the nematode genes for avirulence that they interact with to produce the incompatible (no cysts) phenotypes. Some of these nematode genes are either linked or at the same loci. One inbred has few cysts on Custer but many on Pickett 71; these cultivars were usually considered to have the same genes for resistance.

Publications: 87/01 to 87/12
LUEDDERS, V.D. 1987. Selection Against Heterodera glycines Males by Soybean Lines with Genes for Resistance. Journal of Nematology. 19(4):459-462.
LUEDDERS, V.D. 1987. A Recessive Gene For A Zero Cyst Phenotype In Soybean. Crop Science. Vol. 27, No. 3.

23.067 CRIS0065202
BIOLOGICAL AND CHEMICAL CONTROL OF THE SOYBEAN CYST NEMATODE AND OTHER ROOT DISEASES

DROPKIN V H; Plant Pathology; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00299 Project Type: HATCH
Agency ID: CSRS Period: 03 MAY 74 to 30 SEP 85

Objectives: Develop biological and chemical controls to eradicate or reduce SCN populations and suppress the development of new races. Develop soil assay to determine inoculum density of Macrophomina phaseolina and Sclerotium rolfsii. Develop a selective assay medium for Sclerotium rolfsii isolation. Determine effects of crop rotation and fumigants on the inoculum potentials and disease severity of the soybean root rot complex. Establish disease thresholds for SCN, Macrophomina phaseolina and Sclerotium rolfsii.

Approach: Evaluate crop rotation and fumigation for the eradication or control of the SCN (races 3 and 4) and the soybean root rots as determined by monitoring the SCN and sclerotia populations in each plot by soil assays or by white female cyst counts. Disease thresholds for SCN, Macrophomina phaseolina and Sclerotium rolfsii will be determined by correlating their inoculum potentials and disease severities with yield losses.

Progress: 85/01 to 85/12. Francl (PhD, 1985) took over a rotation experiment begun by Baldwin. Rotations of soybeans with corn, sorghum, or cotton were set up to compare one, two, and three years out of soybeans with continuous soybeans. The experiments were planned to permit within-year comparisons. The data show that three years out of soybeans are required to reduce heavy infestations below economic thresholds. Francl also addressed the validity of the sampling procedures in use at the Delta Center before his work. He found that an increase in the number of cores taken in a W pattern across rows in a plot was more effective than an increase in the number of subsamples. This work was done by applying various sampling procedures to a large data base assembled from cores taken from the field and entered for computer analysis.

Publications: 85/01 to 85/12
NO PUBLICATIONS REPORTED THIS PERIOD.

23.068 CRIS0090208
BIOLOGY AND CONTROL OF SOYBEAN CYST NEMATODE DAMAGE TO SOYBEANS

DROPKIN V H; BLEVINS D G; ANAND S C; Plant Pathology; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00290-4 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 MAY 83 to 31 MAY 86

Objectives: To find genes in soybeans and soybean cyst nematodes (SCN) that affect the diseased caused by SCN. To determine the physiological effects of infection with SCN on soybean plants. To screen resistant soybean germplasm and differentiate between sources of resistance against SCN biotypes. By field experiments, to determine specific roles of N, K, and Zn and other nutrients in of feetting damage caused by SCN.

Approach: Inbred populations of SCN will be crossed for genetic studies. Gel electrophoresis will be used to follow results of crosses. Effects of inbred lines on mineral nutrion of soybeans will be measured. World collection of soybean germplasm will be screened for resistance to races of SCN and genetic studies will be made on resistant lines. Field study will be made to determine optimum levels of K, N, and Zn.

Progress: 87/01 to 87/12. Crosses were made between soybean plant introductions (PIs) resistant to cyst nematode (SCN), to determine whether they have same of different genes for resistance. For each cross, the parents, F(2) plants, F(3) families, and a set of host differentials were evaluated in the greenhouse under controlled regimes. Each seedling was inoculated with 1000 eggs and juveniles of a certain race of SCN. After 30 days, the plant roots were washed to dislodge white females and enumerated. Index of parasitism was calculated and used to classify resistant and susceptible plants. The cross between Peking and PI 90763 did not segregate either in F(2) or F(3) generation for SCN race 3 reaction indicating that these soybean lines had same genes controlling resistance. In the preliminary evaluation the crosses PI 88788 with PI 404198B and PI 438489B segregated in F(2) for one dominant and one recessive gene for race 3 reaction. The F(2) results suggested that PI 90763 and PI 437679 had gene/s in common for SCN race 5 resistance. The cross between Peking and PI 404166 segregated in both F(2) and F(3) generations indicating the presence of one dominant and one recessive genes. The preliminary results in F(2) segregation between Peking and PI 84751 suggested a two gene difference between the parents for resistance to race 5. The F(3) families are being screened to confirm these results.

Publications: 87/01 to 87/12

RAD-ARELLI, A.P. and ANAND, S.C. 1987. Controlling losses to soybean cyst nematode race 5 through genetic mechanism of resistance. Field Day Report 1987. Univ. Missouri, Delta Center DC 2:1-2.

23.069 0138219
SOYBEAN - PLANT PARASITIC NEMATODE INTERACTIONS IN NORTH-CENTRAL MISSOURI

NIBLACK T L; Plant Pathology; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00287 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 89 to 30 JUN 94

Objectives: Determine the identities, distributions, and host relationships of plant parasitic nematodes infesting soybean fields in Missouri; quantify the interactions among Heterodera glycines, soybeans, and other soybean pathogens.

Approach: Standard methods will be employed for nematode collection, processing, identification, and enumeration, and reporting. Field plots in several locations will be used to gather data for modelling field interactions among soybean pathogens and their host. Statistical methods will be appropriate to the experimental designs. Field microplot technology will be employed for investigation of multiple organism interactions and the fates of H. glycines hatch inducing compounds. A fast, reliable laboratory bioassay for hatch induction is under development. Mini-rhizotrons will be used for examining roots of living intact plants, to investigate rhizosphere chemistry and its effect on interactions.

23.070 0150445
INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

NIBLACK T L; Plant Pathology; University of Missouri, Columbia, **MISSOURI** 65211.
Proj. No.: MO-00287-1 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 93

Objectives: Determine the variability in nematode-host interactions; determine the relationships among host, abiotic factors, and crop losses caused by plant-parasitic nematodes.

Approach: Standard methods will be employed for nematode collection, processing, identification, and enumeration, and reporting. Statistical methods will be appropriate to the experimental designs. Field plots in five locations naturally infested with soybean cyst nematode (SCN) will be used to gather data for investigating environmental effects on variability in SCN-soybean interactions. Two of the same sites will be used for SCN overwinter survival studies. Field microplot, minirhizotron, and microelectrode technology will be employed for investigation of rhizosphere interactions between SCN and

soybean lines. Soil samples submitted through extension for analysis will allow qualitative characterization of nematode-host variability in Missouri.

23.071 CRIS0133165
USE OF RECOMBINANT DNA TECHNOLOGY TO STUDY POPULATION GENETICS OF SOYBEAN CYST NEMATODE

POWERS T O; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-21-038 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: 1. To derive estimates of genetic variability within and between populations of Heterodera glycines and evaluate for genetic markers associated with parasitism. 2. To reconstruct from molecular data the history of H. glycines dispersal in the United States.

Approach: We will examine the organelle and nuclear genome of H. glycines individuals from geographically distinct populations. Selected components of H. glycines DNA will be analyzed by restriction mapping, DNA hybridization, and nucleotide sequencing.

23.072* CRIS0027934
PLANT DISEASE SURVEY AND SPECIAL INVESTIGATIONS

WYSONG D S; WATKINS J E; BOOSALIS M G; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-21-001 Project Type: STATE
Agency ID: SAES Period: 01 JUL 66 to 13 MAR 89

Objectives: Monitor plant disease occurrence; determine casal agents of new diseases; deliniate geographic distribution of new and recurring diseases on a periodic basis; make preliminary studies on severity of new or certain recurring diseases; develop judments on feasibility of short-term versus long-term investigations on certain diseases.

Approach: Conduct periodic field examinations for diseases on field crops with particular attention to alfalfa, corn, sorghum, soybeans and wheat; record and maintain records of pathogen identification, disease severity and location, host, and other pertinent data; conduct further study of specific plant diseases collected on survey; study applicability of practical control measure for economically important diseases.

Progress: 87/01 to 87/12. SOYBEANS: A soybean cyst nematode (SCN) survey was conducted in an 8-county area bordering the Missouri River between Richardson County on the south and Burt County on the north. A total of 130 soybean fields were included in the survey, which was initiated in late July and completed in mid-August, 1987. Assays of soil and plant roots collected on survey resulted in the identification of 13 "new" infested fields. The number of fields surveyed by county and the number of confirmed SCN fields (in parentheses) is as follows: Richardson - 20 (4), Nemaha - 20 (2), Otoe - 20 (1), Cass 10 (1), Sarpy - 13 (2), Douglas - 7 (1), Washington - 20 (0), and Burt - 20 (2). While all of the infested fields are associated with low-lying, river bottomland soils, four of the fields were located in the central or western sections out of the Missouri floodplain region. Three of these fields were in Richardson and one was in Douglas counties. SORGHUM: A sorghum downy mildew survey was conducted in a 35-county area in south central, east central and southeastern Nebraska in order to determine the incidence and severity of the disease in commercial fields. A minimum of four fields were selected at random in each county. The disease was found to occur in 17 of the 35 counties; it was considered severe and, in a few fields, was felt to be yield-limiting in a four-county area including Nuckolls, Thayer, Fillmore and Clay counties.

Publications: 87/01 to 87/12
POWERS, T. and WYSONG, D.S. 1988. Soybean Cyst Nematode in Nebraska. Crop Prot. Clinic Proc., pgs. 146-148.
JENSEN, S.G., WYSONG, D.S. and DOUPNIK, B., JR. 1988. Sorghum Downy Mildew, The Disease and its Control. Crop Prot. Clinic Proc., pgs. 123-127.

23.073 CRIS0135028
AN INTEGRATED SYSTEM FOR PEST CONTROL IN SOYBEANS

WILKERSON G; LINKER H; COBLE H D; Crop Science; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC09063 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 88 to 31 AUG 90

Objectives: Develop a pest management system for soybeans which couples a pest data collection and analysis system with computerized decision models for weed, insect, and nematode control. Test and evaluate the system on commercial farms.

Approach: An interactive, menu-driven system will be developed which links together currently available component models and coordinates flow of information. Individual component programs will be modified as necessary to function in tandem. A decision aid for bean leaf beetle control will be developed. After field testing of the combined system, modifications will be made as needed to improve decision algorithms and the user interface.

23.074 CRIS0096106
RESPONSE OF ANNUAL GRASS AND CORN EARWORM POPULATIONS TO SOYBEAN GROWTH ALTERATIONS CAUSED BY SOYBEAN CYST NEMATODE

BRADLEY J R; COBLE H D; SCHMITT D P;
Entomology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC09052 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 15 MAY 85 to 31 MAY 89

Objectives: Determine annual grass population resurgence in soybeans as related to population density of the soybean cyst nematode; determine the relationship of corn earworm oviposition and larval establishment and survival to population density of the soybean cyst nematode; develop an economic model describing the relationship among these soybean pests and their accumulated impact on profit potential.

Approach: Experimental sites will be established in fields naturally infested with the soybean cyst nematode. A range of nematode population levels will be selected from systematically sampled plots. Selected plots will consist of zero levels of weeds and corn earworm (achieved by pesticides) contrasted with naturally developing populations of these pests. Population dynamics of the pests will be determined as well as their impact (singly and collectively) on soybean plant production (biomass and seed yield). Economic models will be developed through standard techniques to describe the relationship among these pests as they affect soybean profit potential under conditions of various densities of nematodes, insects and weeds.

Progress: 87/01 to 87/12. Population densities of corn earworm (CEW) eggs and larvae found on soybean in August were influenced by both soybean cyst nematode (SCN) preplant densities and the presence of weeds in field plots. Numbers of CEW eggs and small larvae were greatest with moderate SCN preplant densities, where soybean plants had an open canopy, but were not severely stunted and chlorotic. Closed canopy soybean with zero to low SCN populations had few CEW eggs and larvae. Numbers of CEW were also negatively correlated to high weed densities in soybeans. Insect species density and diversity, including insect predators of CEW (i.e. Geocoris punctipes, Nabis roseipennis, Orius insidious and Podisus maculiventris), were greatly increased in weedy plots. The percentage of CEW fourth and fifth instar larvae parasitized or infected with NPV (virus) was higher in weedy (36%) than in weed free (28%) plots. However, extent of soybean canopy closure due to SCN densities did not appear to affect CEW parasitism and viral infection. Weed biomass (grams per square meter) increase was related to soybean biomass decrease and increasing SCN preplant densities at one field site. In late August percent defoliation of soybeans due to feeding of CEW larvae was greatest in treatments with moderate and high preplant SCN densities. Total leaf area of 25 randomly selected upper trifoliates per plot was significantly greater in weed free than in weedy plots, however, percent defoliation was not different.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

23.075* CRIS0070699
DAMAGE POTENTIAL AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03546 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Elucidate damage potential of nematodes, especially variable races of Meloidogyne incognita (MI) and M. Arenaria; determine impact of environment on related damage to tobacco and soybean; characterize spatial and temporal populations of nematode; develop and evaluate control tactics; monitor nematode communities species changes; and integrate information on MI on soybean into a simulator.

Approach: Field and microplot experiments will focus on "determinants" involved in nematode-induced crop losses. Evaluate utility of "nematode hazard indices" and economic thresholds. Incorporate data on soybean responses to MI into "CIPM" model. Study biochemical basis of differential virulence and resistance to Meloidogyne spp. on tobacco and mechanisms of nematode suppression of nodulation on soybean. Use findings to improve sampling procedures for advisory purposes. Direct cooperative research toward improving control tactics.

Progress: 87/01 to 87/12. Meloidogyne arenaria (MA) caused more severe damage to peanuts than M. hapla in an interaction study in microplots. Populations of MA differed in their virulence on tobacco. This species, M. hapla, and M. javanica had slight to no effect on the activity of M. incognita (MI) on resistant tobacco. Greenhouse evaluations showed a number of "USDA" tobacco lines to have resistance to one or more of these nematodes. These four root-knot species were found to have differential sensitivity to certain nematicides. Moisture levels affected MI-induced gall development on tobacco as well as leaf growth. Young plants and feeder roots of older Asparagus were found to be susceptible to this nematode. Older roots of this host apparently are resistant to MI. Sphaeronema sasseri and Pratylenchus macrostylus were widespread on Fraser fir and red spruce in the Black Mountains, NC. Both nematode species have low temperature optima.

Publications: 87/01 to 87/12
BARKER, K. R. 1987. Effects of irrigation and cultivar on growth and yield response of tobacco to aldicarb. J. Nematol. 19:511 (Abstr.).
BARKER, K. R., and NOE, J. P. 1987. Establishing and using threshold population levels. In Vistas on Nematology, p.75-81. Veech, J.A., and D.W. Dickson (eds.). Society of Nematologists. E. O. Painter Printing Co., FL.

BARKER, K. R., and NOE, J. P. 1987. Techniques in quantitative nematology, p. 223-236 In Experimental techniques in plant disease epidemiology. Kranz, J., and J. Rotem, eds. Springer-Verlag Berlin. Heidelberg-New York.
BARKER, K. R., STARR, J. L., and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.
CABANILLAS, H. E. 1987. Factors influencing the efficacy of Paecilomyces lilacinus in biocontrol of Meloidogyne incognita on tomato. Ph.D. Thesis, NCSU, Raleigh, N.C. 208 p.
KO, M. P. P.-Y, HUANG, J.-S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83: 229-305.
SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

23.076 0138711
ECOLOGY, PHYSIOLOGY, AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06099 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Develop and improve management tactics for Meloidogyne species and races; characterize the interactions of selected nematodes and their hosts as affected by the environment, especially soil texture, nutrients, moisture, and selected microflora; develop and refine models that characterize the dynamic interactions of Meloidogyne incognita on tobacco, and Heterodera glycines as affected by nematode levels and environment.

Approach: Experiments designed to fulfill the objectives shall be conducted in the greenhouse, laboratory, microplots, and in the field. Management tactics will emphasize cropping systems, biocontrol, resistance, and nematicides. Studies on environmental parameters will focus on their effects on nematode activity (reproduction, survival), and interactions with hosts. Host physiological processes under study include water utilization, photosynthesis, nitrogen metabolism, and mechanisms of resistance to nematodes. Major collaboration research components include those on resistance, nematicides, physiology, and modeling.

23.077 CRIS0131981
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES ON SOYBEAN

BARKER K R; SCHMITT D P; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC01212 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation; to develop efficient systems for intergrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: Resistant lines and cultivars, and cover and rotational crops will be planted in fields infested with H. glycines and/or Meloidogyne spp. The changes in virulence will be monitored and characterized biologically and biochemically. Cropping systems, cultural practices, resistant germplasm, and antagonists of nematodes will be evaluated for the development of effective nematode-management systems.

Progress: 87/01 to 87/12. Long-term cropping experiments were established in the Tidewater region of North Carolina. Late planting limited damage caused by Heterodera glycines (HG) and nematode survival compared to early-season soybeans. All plant-parasitic nematodes present (HG, Pratylenchus spp., Tylenchorhynchus claytoni) generally increased to greater levels in conventional till than in no-till. Corn was the most effective crop tested for depressing population levels of HG. Phytoferritin, a compound which accumulates in nodules of HG - parasitized soybean, was isolated and purified. Antibodies also were made for this ferritin. Damage to soybean by HG or Meloidogyne incognita (MI) was masked by severe moisture stress in microplots. Providing continuous or early season irrigation gave the greatest soybean yields, but severe losses due to these pests also occurred. Viability and biocontrol potential of Paecilomyces lilacinus on MI were affected by various carriers, fungal isolates, and temperature.

Publications: 87/01 to 87/12
BARKER, K.R., STARR, J. L. and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.

23.078 CRIS0132717
QUANTIFICATION AND MODELING OF SOYBEAN RESPONSES AND INTERACTION WITH HETERODERA GLYCINES

BARKER K R; SCHMITT D P; SCHNEIDER S M; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC09058 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 87 to 31 AUG 89

Objectives: Characterize plant damage by the soybean cyst nematode (Heterodera glycines) (SCN) and resulting phenological and

physiological consequences; develop cropping systems to manage the major genetically unstable SCN races; develop a submodel for SCN and interface it to a soybean growth model.

Approach: Link data from planned laboratory, greenhouse, and field studies with data already available to develop improved crop management systems and to construct a research model (simulator) that integrates the impact of H. glycines on soybean. Specific parameters include soybean root and shoot growth and yields as related to transpiration, photo-synthesis and carbon partitioning, nitrogen fixation and mineral metabolism, and nematode levels and reproduction. The proposed predictive nematode simulator will be interfaced with a soybean growth model currently available.

Progress: 87/09 to 87/12. Microplot experiments were conducted to further characterize how soil moisture and type impact soybean growth and yield as affected by Heterodera glycines. Providing adequate moisture when plants were young was more beneficial than at mid to late season. Continuous irrigation resulted in the greatest soybean yields and nematode reproduction compared to other regimes. The basic structure, including primary processes and components, of a sub-simulator for H. glycines on soybean was developed. Logistic nematode developmental models were derived from greenhouse experiments.

Publications: 87/09 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

23.079 CRIS0136382
RESISTANCE MECHANISMS IN SOYBEAN-HETERODERA GLYCINES INTERACTIONS

HUANG J S; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC09353 Project Type: CRGO
Agency ID: CRGO Period: 01 JUL 88 to 30 JUN 90

Objectives: PROJ. 8800786. The objectives of this research are i) to determine the spatial and temporal accumulation of glyceollin I at the sites of nematode infection; and ii) to determine the effects of glyceollin I on physiology and reproduction of H. glycines at the concentrations detected in infected roots.

Approach: Radioimmunoassay and cryostate microtomy will be used to determine levels of glyceollin I accumulated at the sites of nematode infection in various compatible and incompatible soybean cultivar-nematode race combinations. Effects of glyceollin I on respiration, motility, and reproduction on soybean will be investigated.

23.080 CRIS0096635
IRON METABOLISM IN RELATION TO NEMATODE-SUPPRESSED NODULE DEVELOPMENT IN SOYBEAN

HUANG J S; BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC09330 Project Type: CRGO
Agency ID: CRGO Period: 01 JUL 85 to 31 DEC 87

Objectives: Proj 8500645. Determine the effects of the nematode on: iron uptake by soybean roots; Leghemoglobin synthesis; phytoferritin metabolism; and in vitro translation of mRNA.

Approach: Experiments will be conducted using 9Fe as a tracer to quantify effects of Heterodera glycines infection on iron uptake by soybean roots, iron allocation within soybean plants and its incorporation into phytoferritin and leghemoglobins. Leghemoglobins will be extracted from nodules and separated into various components by isoelectric focusing. Phytoferritin will be isolated from nodules and its molecular weight and iron content, numbers of subunits per apoferritin, and molecular weight of each subunit determined. Effects of H. glycines infection on leghemoglobin and phytoferritin will be evaluated. Messenger RNAs will be isolated from nodules of control and nematode-infected soybeans at different developmental stages. In vitro translation of mRNAs will be conducted in a wheat-germ, cell-free protein synthesizing system, and the phytoferritin and Lb translated will be quantified.

Progress: 85/07 to 87/12. Uptake and partition of iron and accumulation of nodular phytoferritin in Heterodera glycines-infected soybean were investigated. Healthy and nematode-infected soybeans were either fed continuously with radioactive 55-Fe or pulsed with the isotope at the specific times. Autoradiography of treated plants revealed that nodules act as an iron sink and that nematode infection suppresses iron uptake. Phytoferritin has been isolated from soybean nodules and purified by preparative and analytical gel electrophoresis. Purified phytoferritin migrated as a single band in gel electrophoresis. Negatively stained phytoferritin had an average diameter of 12 nm with a 6 nm iron core. Native coat protein has a molecular weight of 570 KD and consists of two peptide types, 28 and 29 KD. Monospecific antiserum to phytoferritin has been developed. The antiserum did not cross-react with horse spleen ferritin.

Publications: 85/07 to 87/12
HUANG, J. S. 1987. Interactions of nematodes with Rhizobia. Pages 301-306 in J. A. Veech and D. W. Dickson, eds. Vista on Nematology. Society of Nematology, Hyattsville.
KO, M. P., HUANG, P. Y., HUANG, J. S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83:299- 305.

23.081 CRIS0132502
CONTROL AND REGULATORY MECHANISMS IN PLANT-PARASITIC NEMATODES

OPPERMAN C H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC05643 Project Type: STATE
Agency ID: SAES Period: 01 APR 87 to 31 MAR 88

Objectives: Determine mechanisms involved in control of molting in nematodes, characterize neurological systems present in plant-parasitic nematodes and explore functions, create developmental gene libraries from plant-parasitic nematodes at different stages of host-parasite interaction, characterize mRNA enrichment, characterize regulatory mechanisms involved in formation and maintenance of feeding sites in host plants by plant-parasitic nematodes.

Approach: A combination of genetic manipulation and pharmacological perturbation will be utilized to explore biochemical and cellular mechanisms. Caenorhabditis elegans will be used as a model system where appropriate. Genetic analysis and pharmacology will be combined to: use mutations/resistance to understand drug function, use drugs to identify specific gene alterations, and combine 1 and 2 to analyze control and regulatory function. Standard techniques will be used to create libraries and isolate/translate mRNA.

Progress: 87/04 to 87/12. Experiments to compare the acetyl cholinesterase of the nematodes Caenorhabditis elegans and Meloidogyne incognita (root-knot nematode) were initiated. Preliminary results indicate that enzymes from the two nematodes behave similarly in radiometric assays. Responses to classical cholinesterase inhibitors are comparable although M. incognita appears to be slightly more sensitive than C. elegans. Experiments to compare the biochemical and kinetic characteristics of the nematode enzymes are under way. Research has also been started on the acetyl choline receptor in M. incognita. It appears that C. elegans will be a good model for the study of the cholinergic system in M. incognita and other plant-parasites. C. elegans mixed age populations have been screened against a variety of pharmaceutical agents which interact in several different neurological systems and several drugs which interfere with normal behavior and development have been identified. We are currently attempting to isolate the receptor from the system in which one of these drugs interacts. Further efforts will include mutagenesis, further drug testing, and biochemical analysis to try to identify genes involved in regulatory and control systems.

Publications: 87/04 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

23.082 CRIS0093801
INFLUENCE OF SELECTED SOYBEAN MANAGEMENT PRACTICES ON NEMATODE POPULATIONS

SCHMITT D P; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03892 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To determine crop production systems that manage races of the soybean cyst nematode, effects of straw management practices of population dynamics of the soybean cyst nematode, overseason survival of the soybean cyst nematode, interaction effects of pesticides, damage potential and control methods for reniform, Columbia lance and peanut root-knot nematodes, and more effective control systems for sting, lesion, and northern root-knot nematodes.

Approach: Infested fields will be identified and treatments imposed. Rotation plots will be established in race 2 and/or 5 infested fields. Straw management will be done in fields following corn, wheat, soybean rotation. The wheat straw will be burned or incorporated into the soil. Infection and hatching experiments will be conducted to determine overseason survival of the soybean cyst nematode. Biochemical techniques will be used to determine plant responses to pesticide interactions and nematicides and resistant cultivars will be tested for objectives 5 and 6.

Progress: 87/01 to 87/12. Successful management of the soybean cyst nematode can be linked to certain aspects of its biology and ecology. Low initial populations increase more rapidly during the growing season than high populations. Numbers of soybean cyst decrease with increasing depth and distance from the soybean row. The egg stage is the most reliable life stage for predicting damage to soybean. Race 2 is more pathogenic than race 1 in North Carolina. The tolerance limit for both races was zero or very low in loamy sand and sandy soils, but 315 eggs/500cm soil in muck. An exponential function adequately described soybean yield response relative to nematode control with increasing rates of aldicarb in a loamy sand soil. In general, chemical control of the soybean cyst nematode is not cost effective in conventional or no-till systems. Population increase of the soybean cyst nematode during the growing season is greater in conventional-till than in no-till. Columbia lance nematode, another important soybean pest in North Carolina, requires a combination of tolerant cultivars and nematicides for effective management.

Publications: 87/01 to 87/12
SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybeans to Heterodera glycines races 1 and 2 in different soil types. Journal of Nematology 19:240-250.
SCHMITT, D.P., and NELSON, L. A. 1987. Chemical control of selected plant-patasitic nematodes in soybeans double-cropped with wheat in no-till and conventional till systems. Plant Disease

71:323-326.
ALSTON, D. G., and SCHMITT, D. P. 1987. Population density and spatial pattern of Heterodera glycines in relation to soybean phenology. Journal of Nematology 19:336-345.
BARKER, K.R., STARR, J. L., and SCHMITT, D. P. 1987. The usefulness of egg assays in nematode population determinations. Journal of Nematology 19:130-134.
SCHMITT, D. P., and IMBRIANI, J. L. 1987. Management of Hoplolaimus columbus with tolerant soybean and nematicides. Annals of Applied Nematology 1:59-63.

23.083 0138839
BIOLOGY AND MANAGEMENT OF NEMATODES ON SOYBEAN AND COTTON

SCHMITT D P; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06108 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine aspects of host phenology responsible for diapause in H. glycines; Characterize fitness of H. glycines genotypes to reproduce and survive periods of nonhost; Develop crop production systems that reduce survival and decrease population densities of Heterodera glycines; Characterize the damage functions for Hoplolaimus columbus, Rotylenchulus reniformis, and Paratrichodorus minor on cotton; and evaluate cotton germplasm for resistance to Hoplolaimus columbus.

Approach: Several cropping systems will be evaluated in fields infested with Heterodera glycines to determine which ones will keep populations at a low level. The genetic fitness of this nematode to survive will be characterized using controlled matings then exposing the progeny to a winter environment. Nematode damage functions on cotton will be elucidated in the field in plots selected to give a range of population densities from zero to very high. Cotton germplasm will be evaluated for resistance to Hoplolaimus columbus using a standard inoculum density in the greenhouse.

23.084* CRIS0088272
TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology. Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Ouchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09
RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.
RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

23.085* CRIS0132029
MORPHOLOGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDOGYNIDAE

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

23.086* CRIS0132473
RESPONSE OF COTTON TO HOPLOLAIMUS COLUMBUS POPULATIONS FROM NORTH AND SOUTH CAROLINA

MUELLER J D; LEWIS S A; SCHMIDT D P; Plant Pathology & Physiology; Blackville, **SOUTH CAROLINA** 29817.
Proj. No.: SC-2-3050Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 87 to 31 AUG 89

Objectives: To determine response of cotton to populations of Hoplolaimus columbus, relative aggressiveness of H. columbus from two locations, soil temperature effect on H. columbus reproduction & plant growth, and morphological and cytological differences of four isolates of H. columbus.

Approach: Field plots with 400 1-m row lengths will be marked in each cotton field. Soil cores will be extracted from each plot and six plots from each chosen infestation level will be evaluated for yield. Initial populations isolated from the field plots will be evaluated in yield microplots. Two weeks after emergence plant roots will be stained and examined for nematodes. Seed and lint yields and shoot and root dry weights will be taken at maturity. Initial populations of 0, 25, 50, 100, 200, 400, 800, 1600, and 3200/100 cm soil and temperatures of 14/18 C, 22/26 C, and 32/36 C (diurnal, day/night temperature) will be evaluated for their effect on shoot and root fresh and dry weights and nematode reproduction at the Phytotron. Morphological and cytological assays of four isolates of H. columbus will be prepared and correlated with pathogenicity.

23.087 0137399
RFLP AND MOLECULAR ANALYSIS OF ROOT KNOT NEMATODES, NEMATODE INFECTED PLANTS AND PEACHES

ABBOTT A G; BILLARD R; LEWIS S A; Biological Sciences; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01310 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 89 to 31 DEC 92

Objectives: Generate DNA clones for the construction of RFLP (restriction fragment length polymorphism) maps in peach and for race identification in nematodes; cDNA clones of nematode infected plant tissue will be used to search for plant genes induced during giant cell formation.

Approach: Peach RFLP maps will be constructed using random genomic clones in pUC8 and polymorphisms detected in hybrid peach X almond crosses. Random clones of the nematode species M. ingognita will be screened for polymorphism in biotypes 1, 2, 3 and M. areneria biotypes 1 and 2. Cascade hybridization will identify clones unique to M. incognita infection of soybean tissue. These will be studied in the hypersensitive response.

23.088 CRIS0083048
VARIABILITY OF ROOT-KNOT AND CYST NEMATODES AND FACTORS INFLUENCING THEIR POPULATION DYNAMICS

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC00474 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 80 to 30 SEP 86

Objectives: Characterization of the variability in root-knot and cyst namatodes. Determination of the abiotic and abiotic factors that modify population dynamics of root-knot nematodes.

Approach: Susceptibility of soybean cultivars currently grown in SC will be evaluated against M. incognita and M. arenaria using the gall anf reproduction indices developed by the technical committee. Stability and uniformity of reactions of the 4 races of M. incognita on these cultivars will be mesured. Progeny of M. incognita reproducing on resistant soybeans will be retested to the same cultivars to determine whether they will adapt to those cultivars. Influence of temperature on morphology and survival of M. incognita will be determined. The nematodes will be grown at different temperatures to determine the variation in morphology of perineal patterns.

Progress: 80/10 to 86/09. Reproduction of Meloidogyne arenaria race 2 was excellent on Centennial, Govan, and Kirby soybeans, the latter two being tolerant. M. incognita (Mi) reproduced poorly on Centennial, especially at the higher temperature. Gall and egg mass numbers of Ma plus Mi on Centennial did not differ when Ma was added first and Mi 1, 2, or 3 wk later. At 25 and 30 C, suppression of galls/egg masses occurred when Mi preceded that

of Ma by 2 wk. Kirby was tolerant to either at 25 and 30 C, but in combined infestations synergistic growth suppression occurred. Govan was tolerant of Ma at 25 C but not at 30 C. Moreover, Govan was less vigorous than Centennial at 30 C. Kirby grew well at both temperatures. Microplot tests at sites with different soil types have indicated that soil type and nematode isolate vary in their effect on yield. Soil type was a major factor in eventual yield, with nematode effects varying by isolate. In a general survey, Meloidogyne was often found with other parasitic species but numbers were not correlated with macronutrients, pH, and soil texture.

Publications: 80/10 to 86/09

IBRAHIM, I.K.A. and LEWIS, S.A. 1986. Interrelationships of Meloidogyne arenaria and M. incognita on tolerant soybean. J. Nematol. 18(1):106-111.

23.089 CRIS0088286

THE DISTRIBUTION, ECOLOGY, AND PATHOGENICITY OF ECTOPARASITIC NEMATODES OF SOYBEAN

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01027 Project Type: HATCH
Agency ID: CSRS Period: 01 SEP 82 to 30 DEC 86

Objectives: Determine the distribution of ectoparasitic nematodes on soybean in the Piedmontand Coastal Plain of South Carolina. Evaluate the effect of individual and concomitant species of ectoparasitic nematodes on soybean growth and nematode population dynamics, and evaluate tolerance of soybeans to determine reasons for differences in host suitability to Hoplolaimus columbus.

Approach: Distribution of ectoparasitic nematodes on soybeans will be measured by random surveys and from diagnostic laboratory records. Soil and environmental factors will be analyzed. Soybeans in microplots will be inoculated with predetermined numbers of ectoparasitic nematodes alone and concomitantly. Levels of nematodes will be related to plant damage and yield loss. Lines of soybeans with tolerance to Hoplolaimus columbus will be evaluated in relation to the effect of the nematodes on the host and the host on the nematode population. Host characteristics to be evaluated first include overall size, morphology, and anatomical characteristics. Nematode size, reproducive capacity, and ability to inflict morphological changes will be measured.

Progress: 82/09 to 86/12. The ectoparasite Hoplolaimus columbus (Hc) is common in the Carolinas and Georgia. It can occur with Meloidogyne incognita (Mi) and each species may influence the reproduction and pathogenicity of the other. In greenhouse tests, dry shoot weight (DST) declined linearly and dry rot weight (DRT) nonlinearly with respect to increasing initial populations (Pi) of Mi or the Hc, but in combination suppression of DST and DRT by one species was dependent upon the Pi of the concomitant species. In soil, Hc suppressed Mi but Mi had no effect on Hc. In sterile culture, Mi migrated to noninfected roots rather than Mi-infected or Hc-infected roots or Davis of Centennial soybeans. However, Mi migrated to Mi-infected roots rather than to Hc-infected roots on Centennial but showed no preference on Davis. Hc migrated to noninfected roots of the two cultivars rather than to roots infected with Hc or Mi and to Mi-infected rather than Hc-infected roots of both cultivars when no noninfected roots were present. Actual penetration by Hc on Mi-infected Davis was greater than on noninfected roots. It appears that Mi in Davis roots stimulates penetration by Hc. Hc was attracted to Centennial but very few penetrated the root, regardless of whether Mi was infecting. Population dynamics can be affected by companion species and attractiveness of roots is affected by prior nematode infection. There may be no relation between the attractiveness of a root and its suitability for feeding and reproduction by nematodes.

Publications: 82/09 to 86/12

LEWIS, S.A. 1987. Plant compatibility to nematodes. In: VISTAS ON NEMATOLOGY: A Commemoration of the Twenty-fifth Anniversary of the Society of Nematologists. Accept for pub.

23.090* CRIS0131089

DISTRIBUTION, ECOLOGY AND PATHOGENICITY OF ROOT-KNOT NEMATODE (MELOIDOGYNE SPP.)

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01225 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 87 to 30 MAR 92

Objectives: Determine the subspecific identity of geographical isolates of Meloidogyne spp. in soybean, cotton, and tobacco; determine environmental and edaphic conditions under which physiologic development is favored; and evaluate various host and nonhost plants for nematode management in potential cropping systems.

Approach: Geographical isolates of Meloidogyne incognita and M. arenaria will be identified using host differential plants, perineal patterns of females, male lip shape, cytology, and esterase enzyme profiles. Soil structure, moisture, and temperature relationships will be assessed for their importance in reproduction and aggressiveness of several M. incognita isolates. Life tables will be constructed after determining activity and developmental thresholds of the isolates. Physical and moisture characteristics of two soils will be studied for their influence on egg hatch, movement, invasion, and reproduction. The host suitability of different cultivars of corn, wheat, and sorghum will be assessed against selected isolates of M. incognita. Mass screening of nematode isolates and plant cultivars will be done in the greenhouse and field. This information will be used to develop an economic model of root-knot nematode

management.

Progress: 87/04 to 87/12. Greenhouse and laboratory experiments were performed to determine if an interaction exists between Meloidogyne incognita and Hoplolaimus columbus on Davis soybean. Greenhouse tests were performed with three population levels of M. incognita and H. columbus (0, 15,00, 6,000/1.5-liter pot) separately and in all combinations. Dry root weight (DRT) declined nonlinearly and dry shoot weight (DST) declined linearly with respect to increasing initial populations of M. incognita and H. columbus. When the two nematode species were added to the soil together, the amount of DRT and DST suppression by one species was dependent on the initial level of the concomitant species. The final root population of M. incognita or H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus suppressed M. incognita populations in the soil nonlinearly, but M. incognita had no effect on H. columbus. In other tests, using root explants of M. incognita-susceptible Davis and M. incognita-resistant Centennial, roots parasitized by M. incognita are more attractive to H. columbus than roots of susceptible, and especially M. incognita-resistant soybean ccultivars infected by H. columbus. In susceptible Davis, H. columbus is not only attracted to M. incognita-infected roots but also penetrates these roots more readily than noninfected roots.

Publications: 87/04 to 87/12

GUY, D.W., JR. and LEWIS, S.A. 1987. Selective migration and root penetration by Meloidogyne incognita and Hopololaimus columbus on soybean roots in vitro. J. Nematol. 19:390-392.

GUY, D.W., JR. and LEWIS, S.A. 1987. Interaction between Meloidogyne incognita and Hopolaimus columbus on Davis soybean. J. Nematol. 19:346-351.

23.091 CRIS0131226
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEANS

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01224 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from manipulation. To develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: Cultivars, advanced breeding lines, and suitable material will be tested with isolates of H. glycines and Meloidogyne for comparative reproduction. Nematode isolates from across the region will be used to measure hatch, migration, penetration, establishment, and maturation on cultivars with varying resistance and root morphologies. Biotic and abiotic factors that influence population densities of root-knot and cyst nematodes will be sought.

Progress: 87/01 to 87/12. Virulence of four Meloidogyne arenaria isolates on six soybean selections was evaluated in microplots for 3 years. The Govan, SC isolate had greater reproduction and virulence than the other isolates. Another study conducted over 2 years has shown virulence and reproduction to be greatly influenced by soil structure effects. Considerable variation in virulence on soybean exists among different M. arenaria populations. However, the relative virulence among populations remains stable across soybean genotypes. Species purity of all isolates was continually evaluated utilizing perineal patterns, differential hosts, and esterase pehnotypes on polyacrylamide gels. Esterase phenotypes are able to differentiate species but there is no correlation with virulence of isolates of the species. Though aggressiveness of the isolates differ the relative ranking of varietal tolerance remained the same, indicating management options would not likely be affected.

Publications: 87/01 to 87/12

LEWIS, S.A. 1987. Nematode-Plant Compatiblity. In: Vistas on Nematology: A Commemoration of the Twenty-fifth Anniversary of the Society of Nematologists. J. A. Veech and D. W. Dickson, eds. Published by Society of Nematologists, Inc.

HALBRENDT, J.M., LEWIS, S.A. and SHIPE, E.R. 1987. A modified screening test for determing Heterodera glycines resistance in soybean. Annals of Applied Nematology 1:74-77.

23.092 CRIS0098056
GENETIC MECHANISMS FOR SOYBEAN GERMPLASM DEVELOPMENT

WEISER G C; SHIPE E R; MUSEN H L; Agronomy & Soils; Edisto Res & Educ Center, Blackville, **SOUTH CAROLINA** 29817.
Proj. No.: SC01117 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 86 to 31 DEC 90

Objectives: Identify sources of soybean resistance (or tolerance) to plant parasitic nematodes and insects of importance in South Carolina, and elucidate genetic modes of inheritance and basic genetic mechanisms that confer resistance. Characterize genetic variation and study genetic processes that influence soybean productivity in the Southeastern U.S., e.g., root penetration into compacted soils, and dinitrogen fixation. Investigate genetic male sterility as a technique to improve breeding efficiency of soybean populations adapted to South Carolina.

Approach: Plant Introduction genotypes will be screened for resistance/tolerance to Columbia lance nematode. Mendelian and population genetics studies will be conducted. Inheritance

studies of root penetration lines will be conducted. Plant Introduction genotypes will be screened for inefficient Bradyrhizobium strain exclusion. Genetic male sterile genes will be used to synthesize improved breeding populations of soybean.

Progress: 87/01 to 87/12. Criteria to assess damage on soybean by Columbia lance nematode were developed. Root and shoot weights are significantly reduced by feeding and the reduction is directly related to nematode infestation ($P<0.001$). Lateral root branching, caused by death of root meristems following nematode feeding, can be visually estimated in comparison to tolerant control soybean cultivars. Estimates of branching are significantly related to actual nematode numbers isolated from roots ($P<0.001$). Soybean genotypes identified from USDA Plant Introduction collections have been shown to selectively nodulate with efficient Bradyrhizobium japonicum strains when grown in mixtures of efficient and inefficient strains. The genetic relationships of selective nodulation are presently being determined. Single plant selection is successful in obtaining soybean breeding lines with early maturity (10 days earlier than 'Centennial') and juvenile traits conferring additional plant height (80 cm vs. 45 cm for 'Forrest'). Seed quality is improved in the tall breeding lines due to the presence of genes for hard seed coat.

Publications: 87/01 to 87/12

WEISER, G.C., MUELLER, J.D. and SHIPE, E.R. 1987. Response of tolerant and susceptible soybean cultivars to Columbia lance nematode. Soybean Genet. Newsl. 14: 260-262.

GARNER, E.R., SMITH, T.W., WEISER, G.C., MUELLER, J.D., and SHIPE, E.R. 1987. Criteria to assess Columbia lance nematode damage on tolerant and susceptible soybean cultivars. Agron. Abstr. 79: 62-63.

23.093 CRIS0093491
BREEDING SOYBEAN FOR RESISTANCE TO INSECT AND NEMATODE PESTS

SULLIVAN M J; SHIPE E R; Entomology; Edisto Res & Educ Center, Blackville, **SOUTH CAROLINA** 29817.
Proj. No.: SC01096 Project Type: STATE
Agency ID: SAES Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop soybean cultivars and improved germplasm with resistance to Heliothis zea (corn earworm) and two Meloidogyne species (root-knot nematode). Screen germplasm maturity groups VI, VII, and VIII for better sources of resistance to Heliothis zea (corn earworm).

Approach: Breeding lines will be evaluated for resistance to corn earworm and root-knot nematodes, primarily utilizing natural field populations. Maturity groups will be screened for resistance using natural field populations. Those indicating resistance will be further screened using laboratory and greenhouse techniques.

Progress: 87/01 to 87/12. One hundred and six F5 lines were selected from 778 entries for resistance to Anticarsia gemmatalis (velvetbean caterpillar). Approximately 10% of 420 single plant selections of F4 generation material were resistant to velvetbean caterpillar. The source of insect resistance is PI 229358. Of the 17 advanced breeding lines in the S-157 HPR Nursery rated for velvetbean caterpillar and Pseudoplusia includens (soybean looper) resistance, the following lines had resistant levels approaching that of PI 229358 - NF78-86, F85-2947, F85-2614, F85-2611, and GIR83-296. F8 lines from the cross Braxton X D75-10230 indicated levels of resistance to Meloidogyne arenaria equal to that of the resistant check variety, Gordon.

Publications: 87/01 to 87/12

RODGERS, D.J. and SULLIVAN, M.J. 1987. Development of Palexorista laxa in Heliothis zea larvae fed pest-resistant soybean genotypes. J. Agric. Entomol. 4:201-206.

RODGERS, D.J. and SULLIVAN, M.J. 1987. Growth of Geocoris punctipes (Hemiptera:Lygaeidae) on attached and detached leaves of pest resistant soybeans. J. Entomol. Sci. 22:282-285.

23.094* CRIS0093907
BIOLOGY AND MANAGEMENT OF SELECTED SOYBEAN DISEASES

MUELLER J D; Plant Pathology & Physiology; Edisto Res & Educ Center, Blackville, **SOUTH CAROLINA** 29817.
Proj. No.: SC01098 Project Type: STATE
Agency ID: SAES Period: 01 SEP 84 to 31 AUG 87

Objectives: Determine the races of soybean cyst nematode (Heterodera glycines) present in South Carolina and typify any populations which do not fit one of the five described races. Determine the incidence and severity of stem canker on soybeans in South Carolina and evaluate date of planting, varietal resistance, and fungicides as control measures. Determine the effect of a wheat-soybean double cropping system on the management of lance nematode and fungal diseases of soybeans. Establish rates of nematicides on soybeans.

Approach: Cyst populations will be collected from commercial fields and typified using a set of differential soybean cultivars. Visual ratings will be made on the incidence and severity of ten cultivars planted at two dates. Efficacy of fungicides on a stem canker susceptible cultivar will be visually rated. Reproduction of lance nematode and severity of fungal diseases will be determined on wheat and soybean cultivars grown in a three year double-crop system.

Progress: 84/09 to 87/08. Six soybean cultivars which varied in susceptibility to Diaporthe phaseolorum var caulivora were planted on two planting dates at a total of 5 locations over 2 years. The incidence of naturally occurring stem canker was too low each year to allow comparisons. Thirty-nine

soybean cultivars were field screened at a total of 5 locations over 3 years in North Carolina and South Carolina for tolerance to Hoplolaimus columbus (HC). Cultivars exhibiting the greatest tolerance to HC were 'Asgrow 6785', 'Coker 368', 'Coker 488', 'Kirby', 'RA 680', and 'Young'; the least tolerant were 'Asgrow 6381', 'Braxton', 'Coker 596', 'Hartz 5171', 'McNair 770', and 'Perrin'. Sixteen soybean cultivars were evaluated for performance in a field infested with Heterodera glycines race 3 and Meloidogyne incognita. Yield (kg/ha) was highest for Centennial (1519 kg/ha, 5 new cysts/100 cm soil, galling index of 0.4), Coker 485 (1202, 6, 0.6), Kirby (1519, 0, 0.6), and Gordon (1276, 1, 1). Efficacy of 1.7 and 0.7 kg ai/ha rates of aldicarb 15G, carbofuran 15G, and Fenamiphos 15G was measured on three cultivars varying in susceptibility to (HC) ('Braxton' - susceptible, 'Centennial-tolerant', 'Foster'-tolerant). Mean yield of the 3 cultivars for three years were 1291, 1581, 1668 kg/ha respectively. Mean yield for 2 years over the treatments for the cultivars were 1601, 1628, and 1722 kg/ha respectively. The two aldicarb rates provided equivalent yield increases.

Publications: 84/09 to 87/08

MUELLER, J., SULLIVAN, M. and TURNIPSEED, S. 1986. Control of Hoplolaimus columbus using granular nematicides and tolerant cultivars. J. Nematol. 18:622 (abstr.).

MUELLER, J.D., SHIPE, E.R. and MUSEN, H.R. 1986. Evaluation of soybean cultivars for tolerance to Hoploilaimus columbus. J. Nematol. 18:639 (abstr.).

MUELLER, J.D., MUSEN, H.L. and SHIPE, E.R. 1986. Evalation of resistance in soybean to a combination of root-knot and cyst nematodes. Biological and Cultural Tests for Plant Disease Control 1:35.

MUELLER, J.D. 1986. Evaluation of Telone II for Columbia lance nematode control, 1985. Fungicide and Nematicide Tests 41:79.

MUELLER, J.D. 1986. Evaluation of Telone II for soybean cyst nematode control, 1985. Fungicide and Nematicide Tests 41:80.

MUELLER, J.D. and SANDERS, G.B. 1987. Control of Hoplolaimus colubus on late planted soybean with aldicarb. Annals of Applied Nematology 1:123-126.

MUELLER, J.D. 1988. Efficacy of aldicarb in-furrow and banded on soybean cyst nematode, 1985. Fungicide and Nematicide Tests Volume 43: (in press).

23.095* CRIS0134541

MANAGEMENT OF HOPLOLAIMUS COLUMBUS NEMATODE ON COTTON AND SOYBEAN

MUELLER J D; Plant Pathology & Physiology; Edisto Res & Educ Center, Blackville, **SOUTH CAROLINA** 29817.

Proj. No.: SC01265 Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 88 to 30 DEC 92

Objectives: Determine damage functions for H. columbus on cotton and soybean. Compare pathogenicity of geographic isolates of H. columbus from North Carolina and South Carolina on cotton and soybean. Screen cotton germplasm for resistance or tolerance to H. columbus. Determine chronology, location, and affects of early season infection of cotton and soybean by H. columbus. Determine spatial distribution, overwintering sites, and lifestages of H. columbus in the soil.

Approach: Variation in pathogenicity of H. columbus and levels of host plant resistance will be evaluated using damage functions.

23.096* CRIS0135585

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSSES

SMOLIK J D; Plant Science; S Dakota State University, Brookings, **SOUTH DAKOTA** 57007.

Proj. No.: SD00078 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: Determine the relationship among host, abiotic factors, and crop losses caused by plant-parasitic nematodes. Evaluate the intraspecific variability of plant-parasitic nematodes.

Approach: In cooperation with a Farming Systems Project located at the Northeast Research Station, nematode populations in corn and soybean will be measured in crop rotations under conventional and reduced tillage. A survey for the soybean cyst nematode initiated in 1986 will be continued in cooperation with S.D. Department of Agriculture. Nematode field trials will be conducted in irrigated and dryland corn in eastern and western S.D. Studies will be conducted in both continuously-cropped and first-year corn. Experiments will be arranged in randomized, complete block designs with four to six replications. Nematode populations will be measured at planting, midseason and harvest, and effects on yield will be determined. Tests will utilize both small scale and field-size plots. Several S.D. inbred corn lines appear to possess a useful degree of resistance to Pratylenchus hexincisus and/or P. scribneri.

23.097 CRIS0140774

DEVELOP HOST RESISTANCE AND BIOLOGICAL CONTROL TO MANAGE NEMATODES ON SOYBEANS

YOUNG L D; Nematology Research Unit; Agricultural Research Service, Jackson, **TENNESSEE** 38301.

Proj. No.: 6428-22240-001-00D Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Develop soybean germplasm resistant to multiple races of the soybean cyst nematode, determine response of the nematode to deployment of resistant germplasm, and determine optimum strategies of deploying resistant germplasm. Discover and characterize parasitic microbes of the SCN.

Approach: Identify sources of resistance to SCN, determine mode of inheritance, and develop new soybean germplasm with enhanced multiple pest resistance, including resistance to multiple biotypes. Integrate use of SCN resistant germplasm with other management strategies to minimize yield losses and protect against shifts of biotypes within SCN populations. Determine influence of soybean germplasm with resistance to single and multiple racesof SCN on nematode variability. Determine responses of SCN populations and plant growth to different soil water potentials. Cultures of parasitic microbes will be established from promising sites, such as from these areasin MS where the SCN has decreased in severity on susceptible CUS, assess their parasitic potential in greenhouse experiments, etc.

Progress: 87/01 to 87/12. Eight lines from the Southern soybean germplasm collection were tenatively identified as resistant to soybean cyst nematode (SCN), Heterodera glycines, out of 568 lines screened for reaction to races 3, 4, and 5. Approximately 2,660 enhanced germplasm lines were screened in the greenhouse for SCN resistance, and 250 entries were evaluated for resistance and yield in fields infested with SCN race 4 or 5. For the second year, productive breeding lines were identified with resistance to SCN race 5 and similar SCN populations which reproduce well on race 3-and 4-resistant cultivars. One line, D82-2397A, was identified for probable release as a cultivar. Release of this line will allow growers to reduce yield constraints imposed by SCN race 5. Field testing of management strategies for control of SCN was was continued. For the first time in the nine years of the study, seed yield of resistant cultivar Bedford grown consecutively was significantly less than yields of Bedford grown in rotation with corn and in rotation with susceptible cultivars. Seed yield of susceptible cultivar Forrest grown consecutively was significantly less than yield of Bedford grown consecutively. The data indicates that the SCN population may have changed sufficiently in the Bedford plots to reduce yield of the SCN race 3-and 4-resistant cultivar. Number of SCN cysts in the soil significantly increased when a broad spectrum fungicide was added in a band at planting over rows of a susceptible cultivar.

Publications: 87/01 to 87/12

YOUNG, L.D. 1987. Effects of soil disturbance on reproduction of Heterodera glycines. J. Nematol. 19:141-142.

HARTWIG, E.E., YOUNG, L.D. and BUEHRING, N. 1987. Effects of monocropping resistant and susceptible soybean cultivars on cyst infested soil. Crop Sci. 27:576-579.

TYLER, D.D., CHAMBERS, A.Y. and YOUNG, L.D. 1987. No-tillage effects on population dynamics of soybean cyst nematode. Agron. J. 79:799-802.

23.098* CRIS0091504

DISTRIBUTION AND ECOLOGY OF PHYTOPARASITIC NEMATODES IN TENNESSEE

BERNARD E C; Agricultural Exper. Station; University of Tennessee, Knoxville, **TENNESSEE** 37996.

Proj. No.: TEN00719 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To map the distribution of nematodes in Tennessee, and to elucidate factors responsible for those distributions. To study the interactions of nematodes with their hosts and local environments.

Approach: Collection and identification of nematodes will be made from poorly collected areas of the state and from special vegetation and crop types. The known locations of species will be mapped and compared with topographical, soil, and vegetation maps for elucidation of distribution-limiting factors. Factors responsible for nematode density fluctuations will be studied. Such factors include effect of host absence and climate outside of the growing season, effects of soil fungi and various faunal components, and tillage and double-cropping systems. General environmental effects will be determined by the monitoring of nematode populations throughout two or more growing seasons; the results will be useful in determining the proper times for sampling, and for predicting probable densities in the following growing season. Densities of soil fungi antagonistic to nematodes will be established by a modification of the most-probable-number method.

Progress: 87/01 to 87/12. A survey of plant-parasitic nematodes in virgin areas of the Great Smoky Mountains Natinal Park was continued. An undescribed root-knot nematode (Meloidogyne sp.) was found on hemlock. Perineal patterns of the females are highly reminiscent of M. graminis. Juveniles are large and stocky with a stylet length averaging 16 um. Another nematode was collected with characters similar to Nagelus and Merlinius, but not fitting well into any genus. The nematode fauna of the park's virgin areas is almost completely different from that in agricultural and other disturbed areas. A study was begun on the importance of soil fungi in the regulation of Meloidogyne incognita in commercial tomato fields in east tennessee. Females removed from roots were surface-infested with fungi, mostly Paecilomyces lilacinus, but were rarely infected. Similarly, eggs within egg masses were not parasitized. However, when eggs were embedded in agar on microscope slides and buried for one week, parasitism rates were 15-30%. Females and eggs within egg masses appear to be well-protected from antagonistic fungi, and probably are poor targets for biological control tactics.

Publications: 87/01 to 87/12

BERNARD, E.C. and WITTE, W.T. 1987. Parasitism of woody ornamentals by Meloidogyne hapla. Ann. Appl. Nematol. 1:41-45.

23.099* CRIS0099615
LIFE TABLE STUDIES OF ROOT-KNOT AND CYST NEMATODES

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00822 Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 SEP 86 to 31 AUG 88

Objectives: To develop basic life tables for root-knot (Meloidogyne spp.) and soybean cyst (Heterodera glycines) nematodes.

Approach: Experiments will be conducted in the greenhouse and in growth chambers to determine stage survival rates, life tables, and fertility tables. Stage survival rates will be calculated according to Ruesink's method. Nematode survivorship will be determined for critical life events: hatch, penetration, establishment, maturity, reproduction. The effects on survivorship of nematode source, plant host, initial nematode density, soil type, and temperature will be determined. Three geographically widely separted isolates of M. incognita and N. glycines will be obtained. Each isolate will be tested on three different hosts. Inoculation and infestation techniques will be compared. Each nematode x host combination will be established in sand, loam, or clay loam. Root systems will be harvested at intervals and assayed for nematode life stages. Sex ratios and natural female nortalities will be determined.

Progress: 87/01 to 87/12. The growth and maturation dynamics of Meloidogyne incognita on different plants were studied in containers. Soil within each container was infested with 1,000 eggs and planted with a squash, sunflower, or soybean seedling. Six, 12, 18, 24 and 30 days later, roots were harvested from each set of plants and stained. Nematodes were categorized as non-swollen juveniles, sausage-stage juveniles, and females. Moost of the juveniles entering roots did so within the first six days, but fewer entered sunflower than soybean and squash. Established, swollen juveniles were most abundant at 12 days on squash and sunflower, but at 18 days on soybean. Most of the juveniles on squash and sunflower had matured to females at 18 days, but on soybean had failed to do so in large numbers until 30 days after planting. Soil counts on non-penetrating juveniles were negligible 18 days after planning. Similar experiments are now being conducted with different initial densities, soil types, and nematode isolates to determine their effects on nematode life histories.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

23.100 CRIS0132342
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00842 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation. To develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: Seed of soybean cultivars and advanced breeding lines will be tested with several isolates of H. glycines and major species and races of Meloidogyne for reproduction. Shifts in races and species will be monitored on a regional basis. Life tables will be developed for H. glycines & M. incognita by monitoring population development in greenhouse cultures. The effects of soil texture, temperature, host species, isolate, and initial nematode density will be determined. The influence of cropping systems on the diversity, abundance, and effectiveness of nematophagous fungi will be studied. Floras of cysts and eggs will be compared. The effects of cover crop leachates, exudates and breakdown products of H. glycines will be assessed.

Progress: 87/01 to 87/12. In a study of nematophagous fungi parasitizing Heterodera glycines in wheat-soybean cropping systems, about 100 fungal species were identified. Most of these parasitized eggs within cysts. A more restricted mycoflora was found in white and yellow females; the dominant species were Exophiala pisciphila, Fusarium oxysporum, F. solani, Gliocladium catenulatum, G. roseum, Necosmospora vasinfecta, Paecilomyces lilacinus, and Stagonospora sp. Some fungi were more dominant in no-till systems, while others predominated in conventionally tilled systems. Overall rates of egg parasitism were similar between no-till and conventional till treatments. In experiments conducted to elucidate the role wheat plays in the suppression of H. glycines hatch, dead wheat roots mixed into infested soil reduced hatch of overwintered eggs, but not of eggs collected from greenhouse-grown females. Living wheat roots had less effect than dead wheat roots, and dead sunflower roots had no effect. In another experiment, wheat, sunflower, and nylon filaments mixed into soil all interfered with migration of H. glycines juveniles to soybean roots. Wheat thus appears to suppress hatch of overwintered eggs and to decoy juveniles following straight, cylindrical structures in soil, e.g. roots.

Publications: 87/01 to 87/12
BERNARD, E.C. and SELF, L.H. 1987. Nematophagous fungi in a Heterodera glycines-infested field with different cropping-tillage regimes. J. Nematol. 19:513 (abstr.).

JENNINGS, P.L. and BERNARD, E.C. 1987. Effect of wheat on Heterodera glycines under greenhouse conditions. J. Nematol. 19:533 (abstr.).

23.101* CRIS0137196
SYSTEMATICS, ECOLOGY, AND PATHOGENIC POTENTIAL OF SELECTED PLANT-PARASITIC NEMATODES IN TENNESSEE

BERNARD E C; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00916 Project Type: HATCH
Agency ID: CSRS Period: 01 FEB 89 to 30 SEP 92

Objectives: To identify and describe, when appropriate, plant-parasitic nematodes of potential economic importance, and correlate distribution and abundance of selected nematode species with vegetation and edaphic factors; to determine effects of selected nematode species on host plants.

Approach: Selected crops or plant associations showing stress, or with the potential for being stressed, will be sampled on a field-by-field basis, by plant associations, or by transect. Two major surveys will be conducted: A) on clover pastures and soybean fields to determine the range of a new root-knot nematode species, and B) in all regions of the Great Smoky Mountains National Park, where some species may be contributing to tree declines. Findings will be correlated with edaphic and vegetation factors by means of similarity indices and computer-assisted cluster analysis. Dorylaimid nematodes in the genera Tylencholaimellus and Dorylaimellus will be reared in the greenhouse on corn. Nematodes will be surface-sterilized, then placed on agar plates containing corn callus or excised roots. Nematodes will be observed for feeding and reproduction. An underscribed root-knot nematode parasitic on clover and soybean will be studied to determine host range, pathology on the root system, effects on nodulation, and quantification of damage.

23.102 CRIS0097325
ETIOLOGY, ECOLOGY, AND CONTROL OF SOYBEAN DISEASES

CHAMBERS A Y; Entomology & Plant Pathology; University of Tennessee, Knoxville, **TENNESSEE** 37996.
Proj. No.: TEN00812 Project Type: HATCH
Agency ID: CSRS Period: 01 DEC 85 to 30 SEP 89

Objectives: To identify and study the life cycles of soybean pathogens. To determine effects of disease organisms on soybean growth, development, and yield. To determine the influence of the environment on disease development. To develop methods for controlling or reducing losses caused by diseases.

Approach: Disease organisms will be isolated from diseased plant material, identified, tested for pathogenicity and studied under laboratory and greenhouse conditions and the life cycles of the pathogen determined if unknown. Soybeans will be inoculated in greenhouse and field experiments with selected pathogenic organisms alone and in combination and the effects on growth, development, and yield and quality of seed assessed. The influence of temperature, light, moisture, and pH on growth development and pathogenicity of the pathogen collected and identified will be studied in laboratory, greenhouse, and field experiments. In addition the influence of different tillage systems will be investigated. Various control measures, including biological, cultural, resistant cultivars, and chemical controls will be evaluated for the major diseases encountered above.

Progress: 87/01 to 87/12. Twenty-one experiments were conducted on major soybean diseases in Tennessee and their control. Fungicide seed treatments improved stands and yields under conventional and no-till conditions. Efficacy of liquid hopper-box seed treatments was comparable to conventional seed treatments. Hopper-box dust treatments were less effective. In-furrow fungicide treatments were not as effective as seed treatments. Yields were increased in two of four nematicide experiments for soybean cyst nematode control. White female nematode ratings made 30 days after planting indicated good control with 10 new nematicides. Nematode control and yields were similar to recommended aldicarb treatments. Cyst nematode populations did not increase as rapidly in no-till as in conventional-tillage soybeans in three experiments. Brown spot and anthracnose were less severe with no-till than with conventional tillage, but stem canker incidence was moderately higher. Foliar diseases were not as severe as in previous years. Disease injury was reduced, and yields were increased following fungicide applications in two experiments. Stem canker injury was not as severe as in 1986. Disease rating and yields of 28 cultivars and lines in two experiments showed one new cultivar, 'FFR 562', had a high level of stem canker resistance. 'FFR 561' and 'Shiloh' continued to show a high level of resistance; 15 cultivars and lines were found to be very susceptible.

Publications: 87/01 to 87/12

TYLER, D.D., CHAMBERS, A.Y. and YOUNG, L.D. 1987. No-tillage effects on population dynamics of soybean cyst nematode. Agron. J. 79:799-802.
CHAMBERS, A.Y. 1987. Effects of potash fertilization on severity of soybean stem canker. Proc., Southern Soybean Disease Workers Fourteenth Annual Meeting. p. 90.
CHAMBERS, A.Y. and NEWMAN, M.A. 1987. Sudden death syndrome causing problems in Tennessee soybeans. Tennessee Farm Magazine 37(2):7.

23.103* CRIS0131690
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

STARR J L; Plant Pathology & Microbiology; Texas A&M University, College Station, **TEXAS** 77843.
Proj. No.: TEX07121 Project Type: HATCH
Agency ID: CSRS Period: 08 MAY 87 to 30 SEP 91

Objectives: 1. To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: Field microplots will be infested with a population of race 3, race 4, or both of M. incognita. A rotation system of cotton, sorghum, and resistant soybeans will be imposed on each plot. After each growing season several single egg mass isolates from each treatment will be collected and increased on tomato. Resulting populations will be race typed to determine rates of change in race status, if any. In arid regions various skip row planting systems are sued to conserve limited soil moisture. The use of a precision planting system, whereby rows to be planted are always placed over rows fallowed the previous year, will be tested to determine possible benefits in nematode control.

Progress: 87/05 to 87/12. This is a newly established regional project and few studies are yet complete; current project activities are centered on two approaches to management of root-knot nematodes. The first approach is a cultural method whereby skip-row planting systems used to conserve soil moisture in arid regions will be exploited to suppress nematode populations. Long-term (3 yr) experiments have been established to examine the benefit of planting only over rows fallowed the previous year in the skip-row planting system. The other approach to management is the development of root-knot resistant cultivars in crops that are attractive as rotational crops for soybean. Peanut is naturally resistant to soybean cyst nematodes and Meloidogyne javanica and M. incognita. If resistance to M. hapla and M. arenaris can be incorporated into acceptible peanut cultivars, then peanut would be an acceptable rotational crop for soybean. We have begun screening exotic Arachis species germplasm for useful sources of resistance to M. arenaria and M. hapla.

Publications: 87/05 to 87/12
WIGGERS, R., STARR, J.L. and PRICE, H.J. 1987. DNA content of Meloidogyne - induced giant cell nuclei. J. Nematol. 19:562 (Abstr.).
WHEELER, T.A. and STARR, J.L. 1988. Incidence and economic importance of plant-parasitic nematodes on peanuts in Texas. Plant Science:In press.

23.104 CRIS0131083
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

EISENBACK J D; Plant Pathology Physiology & Weed Science; Virginia Poly Inst, Blacksburg, **VIRGINIA** 24061.
Proj. No.: VA-136057 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation. To develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: The interaction of soybean germplasm resistance and nematode virulence will be determined in a uniform regional test. Each cultivar will be tested with several different isolates of H. glycines and major species and races of Meloidogyne for reproduction and compared to a standard susceptible host. Nematode races and species will be monitored by standard differential host tests for regional shifts in race and species composition. The role of biological antagonists in the management of H. glycines and Meloidogyne spp. will be determined. Specificity and relative infectivity of antagonist isolates from across the region will be determined.

Progress: 87/01 to 88/09. Identification of root-knot nematodes (MELOIDOGYNE species) parasitizing soybean in Virginia revealed that M. HAPLA was the most common root-knot species, and that M. INCOGNITA and M. ARENARIA were present but less common. In addition an unusual morphologic form of root-knot nematode resembling both M. HAPLA and M. CHITWDDDI was detected in several counties reproducing in soybean. Since few reports have evaluated soybean cultivars for resistance to M. HAPLA, 57 cultivars and advanced breeding lines were screened for resistance to the northern root-knot nematode. All of the established cultivars were good hosts, however, one advanced breeding line, V85-41, was very resistant. This promisingly resistant soybean line is being screened for resistance to additional population of M. HAPLA from the two cytological races including nine chromosomal forms. In a search for more reliable morphological characters for the identification of soybean cyst (HETERODERA CLYCINES) and tobacco cyst nematodes (GLOBDDERA TDBACUM), the styletextraction technique has been improved for use with these nematodes. Aqueous solutions of 0.01% sodium hypochlorite proved to be satisfactory for both genera.

Publications: 87/01 to 88/09
EISENBACK, J.D., 1988, Reproduction of the northern root-knot nematode, Meloidogyne hapla on three species of marigolds., Virginia Academy of Science 39:94 (abstract)
MOTA, M.M., and EISENBACK, J.D., 1988, Optimization of stylet extraction in cyst nematodes, Virginia Academy of Science 39:97 (abstract)

MOTA, M.M., and EISENBACK, J.D., 1988, SEM observations of stylets of different life stages of the horsenettle cyst nemaode (Nematoda;Herteroderidae)., IBEREM Joint Meeting of Portuguese and Spanish Soc. of Elec. Micros

24.001* CRIS0091501
MANAGEMENT SYSTEMS FOR THE CONTROL OF DISEASES AND NEMATODES OF PEANUTS AND SOYBEANS

BACKMAN P A; RODRIGUEZ-KABANA R; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: ALA00614 Project Type: HATCH
Agency ID: CSRS Period: 05 OCT 83 to 30 SEP 89

Objectives: Assess damage and economic loss to peanuts and soybeans caused by nematode and fungal pathogens. Evaluate systems for control of important pathogens within a framework of sound production economics.

Approach: The economic importance of diseases and nematodes of peanuts and soybeans will be evaluated on an individual basis by adjusting pest levels with pesticide and subsequently determining host response. Later studies will evaluate multiple pest systems for their combined effects on the host. Chemical, biological, and cultural control systems will be evaluated for control efficiency relative to each other, and for economic return in an overall management system. These management systems will be developed with extensive utilization of losses, stress loading, epidemiology, disease progress, and population dynamics.

Progress: 87/01 to 87/12. The efficacy of 'Deltapine 90' cotton in rotation with 'Florunner' peanut for the management of Meliodogyne arenaria was studied for 2 years. In 1985, M. arenaria juvenile populations were 98% lower in plots with cotton than peanut plots. Peanut and cotton yields were increased by treatment with aldicarb (3.3 kg a.i./ha in a 20-cm-band) in 1985 but not in 1986. In 1986, peanut yields were highest and M. arenaria juvenile populations were lowest in plots planted to cotton in 1985. In 1986, numbers of M. arenaria juveniles in plots with peanut both years were reduced by treatment with aldicarb to levels found in plots with cotton-peanut rotation. Cotton-peanut rotations resulted in management of M. arenaria and increased peanut yields without the use of nematicides. Studies on biological control utilizing chitin-based soil amendments demonstrated that several formulations provided effective control of M. arenaria in the greenhouse, microplots, and field experiments on several types of crops. Studies on the biological control of foliage pathogens revealed that antagonists applied to leaf surfaces alone did not suppress pathogens, while either a selective foodbase added in conjunction with the antagonist, or the foodbase added to leaf surfaces without the antagonist suppressed Cercospora leafspot of peanuts. The foodbase was shown to sustain growth of added antagonists, for up to 3 weeks.

Publications: 87/01 to 87/12

PEDERSEN, J.F. and ROORIGUEZ-KABANA, R. 1987. Nematode response to cool season annual graminaceous species and cultivars. Annals of Applied Nematology 1:116-118.
RODRIGUEZ-KABANA, R., MORGAN-JONES, G. and CHET, I. 1987. Biological Control of Nematodes: Soil Amendments and Microbial Antagonists. Plant and Soil 100:237-247.
RODRIGUEZ-KABANA, R., IVEY, H. and BACKMAN, P.A. 1987. Peanut-cotton retations for the management of Meloidogyne arenaria. Journal of Nematology 19(4):484-486.
ROORIGUEZ-KABANA, R., ROBERTSON, D.G. and KING, P.S. 1987. Comparison of methyl bromide and other nematicides for control of nematodes in peanut. Annals of Applied Nematology 1:56-58.
ROORIGUEZ-KABANA, R., WEAVER, D.B. and KING, P.S. 1987. Soybean response to a planting-time application of ethylene dibromide in a soil infested with Meloidogyne incognita, M. arenaria, and Heterodera glycines.
WEAVER, D.B., RODRIGUEZ-KABANA, R. and CARDEN, E.L. 1987. Soybean response to ethylene dibromide in a soil infested with Meloidogyne arenaria and Heterodera glycines. Annals of Applied Nematology 1:94-96.
BACKMAN, P.A. 1987. Control of peanut soilborne diseases may afford yield breakthrough. Ala. Agric. Exp. Stn. Highlights Agr. Res. 34(4):.

24.002* CRIS0096818
TAXONOMY AND ECOLOGY OF MYCOFLORAS IN ALABAMA AGRICULTURAL SOILS

MORGAN-JONES G; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: ALA-05-0066 Project Type: STATE
Agency ID: SAES Period: 01 OCT 85 to 30 SEP 90

Objectives: Identify fungal species and characterize their relationships to microhabitats in soil. Define the physiological and ecological factors controlling fungal growth in soil.

Approach: A number of specialized ecological niches and microhabitats such as nematode cysts, body cavities of soil microarthropods, root surfaces and organic particles will be examined for the presence of fungi. Nematode cysts and microfauna will be extracted from soil by flotation and Baermann funnel techniques respectively. Taxonomic studies on isolated fungi will be conducted where warranted and determination made of factors affecting their growth in soil and their capacity to degrade various substrates and to parasitize other microorganisms.

Progress: 87/01 to 87/12. Research has continued on the potential of opportunistic soil-borne fungi, belonging to the genera Gliocladium, Myrothecium, Ulocladium and Verticillium, for biological control of phytonematodes in Alabama agricultural soils. The effectiveness and mode of action of certain organic amendments to soil for management of nematode population dynamics have been investigated further, with particular attention being paid to stimulation of antagonistic mycofloras. Organic matter can be modified by addition of specific compounds to selectively enhance populations of certain fungi in soil or can be inoculated with particular species prior to introduction. In each case some success has

been achieved in designing amendments that will induce suppressiveness. Attention has been paid to factors, including fungistasis and competitive ability, that regulate effective establishment of introduced species. Some fungi, such as Gliocladium roseum,have been found to establish readily while others, such as Verticillium chlamydosporium, do not compete as effectively in most soil agroecosystems. Further research on fungal endophytes of pasture grasses has been conducted and a number of new taxa recognized and described. These include Acremonium chisosum, A. huerfanum and A. starrii. A new, comprehensive description of the Acremonium anamorph (A. typhinum) of Epichloe typhina, the causal organism of choke disease of grasses, was published.

Publications: 87/01 to 87/12

MORGAN-JONES, G. and RODRIGUEZ-KABANA, R. 1987. Fungal biocontrol for the management of nematodes. Chapter 14 in Vistas on Nematology, Society of Nematologists: pp. 94-99.

RODRIGUEZ-KABANA, R., MORGAN-JONES, G. and CHET, I. 1987. Biological control of nematodes: soil amendments and microbial antagonists. Plant and Soil 100:237-247.

CARRIS, L.M., GLAWE, D.A. and MORGAN-JONES, G. 1987. Stagonospora heteroderae, a new species isolated from cysts of Heterodera glycines. Mycotaxon 29:451-455.

WHITE, J.F. and MORGAN-JONES, G. 1987. Endophyte-host associations in forage grasses. VII. Acremonium chisosum, a new species isolated from Stipa eminens in Texas. Mycotaxon 28:178-189.

WHITE, J.F. and MORGAN-JONES, G. 1987. Endophyte-host associations in forage grasses. IX. Concerning Acremonioum typhinum, the anamorph of Epichloe typhina. Mycotaxon 29:489-500.

MORGAN-JONES, G. and BURCH, K.B. 1987. Studies in the genus Phoma. VIII. Concerning Phoma medicaginis var. medicaginis. Mycotaxon 29:477-487.

MORGAN-JONES, G. and BURCH, K.B. 1987. Studies in the genus Phoma. IX. Concerning Phoma jolyana. Mycotaxon 30:239-246.

24.003 CRIS0134592

DEVELOPMENT OF MICROCOMPUTER-BASED PEANUT PEST MANAGEMENT SYSTEM

MACK T P; BACKMAN P A; RODRIGUEZ-KABANA R; Entomology; Auburn University, Auburn, **ALABAMA** 36830.

Proj. No.: ALA-50-0077
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 APR 88 to 31 MAR 90

Objectives: Develop accurate pest prediction and yield/economic loss algorithms for the major insects, diseases, and nematodes attacking conventionally planted and tilled peanuts. Integrate the above algorithms obtained from objective one into a microcomputer-based peanut pest management system. Calibrate the system with one year's field data.

Approach: A systems approach will be used to develop algorithms from available research and proposed studies. The algorithms will describe pest population establishment and development, crop loss, and will relate profitability to pest abundance. A prototype management system will be developed from these algorithms, and it will be similar to AUSIMM, the Auburn University Soybean Integrated Management Model.

24.004 CRIS0083292

VARIABILITY OF ROOT-KNOT AND CYST NEMATODES AND FACTORS INFLUENCING THEIR POPULATION DYNAMICS

DICKSON D W; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02054 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 80 to 30 SEP 86

Objectives: Characterization of the variability in root-knot and cyst nematodes. Determination of the abiotic and biotic factors that modify population dynamics of root-knot and cyst nematodes.

Approach: Specific enzymes of females from collections of M. arenaria and M. javanica obtained from technical committee members throughout the southern region will be investigated by.microelectrophoresis and isoelectric focusing. Enzyme analyses by disc electrophoresis will also be conducted on root-knot nematodes found in southern region other than M. arenaria, M. javanica, M. incognita and M. hapla. Populationsoof M. hapla, M. arenaria, M. incognita, and M. havanica will be evakyated fir sysceptiblitiy to selected collections of a bacterial spore parasite of nematodes. The differential effect of organophosphate and carbamate nematicides will be evaluated on M. arenaria, M. incognita and M. javanica.

Progress: 85/10 to 86/09. Polyvinylchloride (PVC) columns 45,60,90, and 120cm long x 12.7 cm internal diameter were packed with pasteurized soil and buried vertically in a field naturally infested with Meloidogyne arenaria race 1.A15 cm long x 12.7 cm diameter PVC root chamber with the top and bottom covered by plexiglass (15 cm x 15 cm x 0.3 cm) and nylon monofilament screen cloth (15 um openings), respectively, was glued and taped to each column and filled with pasteurized soil. A single bare root tomato seedling was transplanted into the root chamber through a 1.5 cm hole in the flat plexiglass covering. A duplicate of each tube was placed in the field and replicated four times. Fifteen to 20 egg masses of a greenhouse culture of M. arenaria race 1 were placed at the bottom of duplicate tubes. Clay saucers were used to seal the bottom of control tubes. Juveniles of the field population migrated at the rate of 2 to 4 cm per day. They moved a distance of 45 or 120 cm and induced galls on the tomato seedling in 13 and 29 days, respectively. In every case the inoculated juveniles induced a greater number of galls than did the field population.

Publications: 85/10 to 86/09
DICKSON, D.W. and HEWLETT, T.E. 1985. Vertical migration of Meloidogyne arenaria in soil columns in the field. European Society of Nematologists. XVIII International Nematology Symposium.

24.005* CRIS0096489
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

DICKSON D W; DUNN R A; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with field corn, peanut, soybean, and forage crops grown in Florida, and to design and evaluate management strategies to reduce economic losses on these crops.

Approach: The population dynamics and economic damage levels of Pratylenchus brachyurus and Mel Meloidogyne arenaria on peanut and P. brachyurus and Paratrichodorus sp. on corn will be established. The efficacy of fumigant and nonfumigant nematicides for management of nemas on peanut and corn will be investigated. A crop rotation management scheme will be evaluated for managing M. arenaria on peanut. The population dynamics of nemas in minimum tillage-multicropping systems will be monitored. Host-parasite relationships and economic damage relationships of Meloidogyne spp. to soybeans and of various nematodes including Belonolaimus spp. and Meloidogyne spp. to forage crops will be investigated. In cooperative efforts with plant breeders, germ plasm of forage crops, primarily legumes, will be screened for reactions to Meloidogyne spp.

Progress: 87/10 to 88/09. Three tests were conducted to evaluate the efficacy of fumigant and nonfumigant nematicides for control of Meloidogyne arenaria race 1 on peanut. Methyl bromide, 1, 3-D, methyl isothiocyanate, methyl isothiocyanate mixtures, aldicarb, ethoprop, fenamiphos, and F5145 were evaluated by different methods of application preplant, at plant or at early flowering. Of the 32 treatments evaluated, only seven resulted in yield increases ($P = 0.05$) although early season vigor was high in all treated plots. During the latter one-third of the growing season, however, nematode control was not adequate in most treatments resulting in heavy peg, pod, and root infection by M. arenaria. Four populations of Pratylenchus brachyurus were tested in a greenhouse on selected plant species to determine host suitability and usefulness inidentifying physiological races of the nematode. The differential plants were alfalfa, snap bean, citrus, corn, peanut, soybean, and tomato. Fresh shoot or root weights of plants inoculated with all populations were similar to each other and to the uninoculated control in both experiments. The numbers recovered from snap bean were different ($P = 0.05$) between populations in each test and from soybean in the second test. The differences between populations on snap bean were different in 2 tests. The effect of two cropping and tillage systems on the population dynamics of 4 nematode species was evaluated.

Publications: 87/10 to 88/09
PAYAN, L.A. and DICKSON, D.W. 1988. Host specificity of four populations of Pratylenchus brachyurus. Ann. Appl. Nematol. 2 'in press'.
GALLAHER, R.N., DICKESON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Tillage and multiple cropping systems and population dynamics of phytoparasitic nematodes. Ann. Appl. Nematol. 2 'in press'.
DICKSON, D.W. and HEWLETT, T.E. 1987. Effect of two nonfumigant nematicides on corn grown in two adjacent fields infested with different nematodes. Ann. Appl. Nematol. 1:89-93.
DICKSON, D.W. and MCSORLEY, R. 1987. Standarization of nematicide application rates. Ann. Appl. Nematol. 1:1-5.
DICKSON, D.W. 1984. Cultural control of nematodes. Pp. 40-45. United States Department of Agriculture, Agricultural Research Service. Nematology Workshop. Oct. 15-18.

24.006* CRIS0134264
APPLICATION OF POPULATION ECOLOGY IN THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

MCSORLEY R T; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02700 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: To assess and improve the efficiency of methods for extracting nematodes from soil. To develop sampling plans for plant-parasitic nematodes in small plots. To develop damage functions for plant-parasitic nematodes on selected agricultural crops. To determine the impact of selected crops and cover crops on dynamics of plant-parasitic nematodes. To investigate the impact of predators on dynamics of nematodes and their potential for biological control. To investigate the impact of selected nonchemical nematode management techniques, such as solarization, use of resistant or tolerant cultivars, and the cropping systems approach.

Approach: Field plots in sites containing gradients in nematode density will be used to derive damage functions and critical point models of nematode population increase. Taylor's power law will be used in the development of sampling plans.

Progress: 88/06 to 88/10. Work on this project has been initiated within the past several months. Data collected during the 1988 growing season is being used to develop damage functions for the sting nematode, Belonolaimus longicaudatus, on corn and soybean. On each crop, relationships between initial and final populations are being developed for B.

longicaudatus, Meloidogyne incognita, Pratylenchus branchyurus, and Criconemella spp. Additional field data collected during 1988 are being used to develop sampling plans for these nematodes in small plots. Plant damage functions and nematode population growth functions have been derived for P. brachyurus on peanut in Queenland, Australia, and integrated into a simple management model for testing during the current growing season.

Publications: 88/06 to 88/10

MCSORLEY, R. and O'BRIEN, P.C. 1988. Application of modelling techniques for integrating management options on peanuts. Australian Nematologists' Newsletter 7(2):15-17.

24.007* CRIS0092658

BIOLOGICAL CONTROL OF PLANT PARASITIC NEMATODES AND OF INSECTS BY ENTOMOGENOUS NEMATODES

SMART G C JR; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02433 Project Type: STATE
Agency ID: SAES Period: 06 MAR 84 to 31 DEC 88

Objectives: To evaluate organisms such as fungi, bacteria and antagonistic plants as biological control agents of plant parasitic nematodes. To evaluate entomogenous nematodes as biological control agents of noxious insects.

Approach: The fungus, Paecilomyces lilacinus, will be used in experiments to control the root-knot nematode, Meloidogyne incognita. The fungus will be used alone and in conjunction with the bacterial spore parasite, Bacillus penetrans. B. penetrans also will be used alone. Other fungi and other nematodes may be used in future experiments. Antagonistic plants to be used are the digitgrasses, Pangola digitgrass initially against M. incognita and Transvala digitgrass against the sting nematode, Belonolaimus longicaudatus. Initial research will be with Neoaplectana carpocapsae against the mole crickets Scapteriscus acletus and S. vicinus.

Progress: 87/10 to 88/09. For more than three years after release of a Neoaplectana sp. (formerly called N. carpocapsae = Steinernema) from Uruguay in three small (50 m2) plots, the nematode is still causing about a 10% infection of mole crickets. The nematode has spread from the release sites (at least 5 miles after three years), and mole cricket populations, as measured by capture of nymphs in pitfall traps, has gone from an average of 93 lymphs before treatment to 16 one year later to 6 after two years and to 4 after three years. Damage to the grass has decreased. When placed on the soil surface or just under it, the infective-stage juveniles moved downward 10 cm, infected and killed mole crickets in dishes below. They moved downward as readily outdoors in field soil as in containers of soil in the laboratory, and in fact, killed mole crickets more efficiently in the field with a concentration of nematodes 5 times less than in the laboratory. When placed in the center of a soil column, the nematodes moved both upward and downward 8 cm with a greater number moving down than up. Infective-stage juveniles were buried in the soil in tightly sealed containers or in containers covered with 10 um Nitex cloth. In both types of containers the nematodes survived and were able to kill mole crickets after the 8 or 10 weeks of the tests. Even though the numbers that survive are reduced rapidly during the first week, numbers decline much more gradually during subsequent weeks.

Publications: 87/10 to 88/09

OLEXA, M.T. and SMART, G.C., JR. 1987. Pesticides and public employee liability. Journal of Nematology 19:549 (Abstr.).

GERBER, K., SMART, G.C. and ESSER, R.P. 1987. A comprehensive catalog of plant parasitic nematodes associated with aquatic and wetland plants. Bulletin 871 (Technical) 170 pp. Agric. Expt. Sta., IFAS, Univ. Fla., Gainesville.

NGUYEN, K.B. and SMART, G.C., JR. 1988. Mode of entry of neoaplectanid nematodes into mole crickets. Soil and Crop Science Society of Florida, Proceedings 47:250 (Abstr.).

24.008* CRIS0096488

BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

KINLOCH R A; Agr Res Cntr; University of Florida, Jay, **FLORIDA** 32565.
Proj. No.: FLA-JAY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 88/01 to 88/12. Winter planting of Cahaba White vetch, Vantage Purple vetch, ryegrass, and wheat were not significantly different from winter fallow in their effects on the soil infestation levels of the rootknot nematode Meloidogyne incognita and on subsequent galling and yields of rootknot susceptible (Hartz 7126) and resistant (Hartz 7110) soybean cultivars. Galling and yield of the susceptible cv over all winter treatments were 2.7 (on a scale of 0-4) and 1228 kg/ha; whereas those of the resistant cv weere 0.1 and 2269 kg/ha. Field studies were initiated to study the influence of summer planted crops

(soybean, sorghum, maize, alyceclover, millet, sorghum X sundangrass, lespedeza, hairy indigo, peanut, aeschynomene, and cotton) on the abundance of Meloidogyne arenaria. In evaluations of 34 public and commercial cultivars and breeding lines at a site infested with M. arenaria, yields ranged from 111 kg/ha (DP 497, galling = 3.8 on a scale of 0-4) to 1591 kg/ha (Asgrow 6785, galling = 1.8). Yield of all cultivars (Y) was related to galling (X) by Y = 2084-475X, r = -0.77 (P < 0.01). At a site infested with M. incognita yields ranged from 999 kg/ha (S69-96, galling = 2.6) to 2941 kg/ha (Coker 6847, galling = 0.3). Yield was related to galling as Y = 2691-430X, r = -0.65. At a site infested with the soybean cyst nematode Heterodera glycines (Race 3) yields ranged from 1221 kg/ha (Cobb) to 2793 kg/ha (Coker 6847).

Publications: 88/01 to 88/12

KINLOCH, R.A. 1988. Incidence of nematode trophic groups in a native woodland soil and in adjacent agricultural soil planted to various crops. Proc. Soil Crop Sci. Soc. Florida 47: 249-250.

KINLOCH, R.A. and RODRIQUEZ-KABANA, R. 1989. Rootknot nematode disease. In Compendium of soybean diseases. American Phytopathological Society. (In press).

24.009* CRIS0140338

NEMATODE AND INTEGRATED PEST MANAGEMENT SYSTEMS FOR THE SOUTHEASTERN COASTAL PLAIN

JOHNSON A W; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.

Proj. No.: 6602-24000-007-00D

Project Type: INHOUSE

Agency ID: ARS Period: 02 AUG 85 to 01 AUG 90

Objectives: Develop integrated pest management systems and models that are effective, energy efficient and economically suitable for managing and predicting populations of plant-parasitic nematodes in intensive vegetable and agronomic cropping systems under irrigation.

Approach: Field tests (using standard and new techniques) will be conducted to determine the effects of cultural practices, crop rotations, cover crops, resistant varieties, tillage methods, irrigation, chemicals and levels of pest management on nematodes, soil-borne fungi, insects, and weeds on intensive horticultural and agronomic crop production systems. Nematode population densities, root-gall indices, seedling diseases, crop response, yield and quality will be recorded. The fate and efficacy of nematicides in soil and groundwater will be determined. The research will be conductedin cooperation with agricultural engineers, agronomists, horticulturists, economists, entomologists, plant pathologists, weed scientists, modelers, and research chemists.

Progress: 87/01 to 87/12. Numbers of root-knot nematode juveniles in intensive cropping systems were <5/150 cc soil in all plots of vegetable crops, except onion and cowpea, following tobacco, and lettuce following sweet corn. The nematode species were 100% Meloidogyne incognita on onion and lettuce, and 70% M. incognita and 30% M. arenaria on cowpea. Numbers of root-knot nematodes were <25/150 cc soil in plots of soybean, cotton, peanut and winter oats prior to planting spring crops. Yields of millet, a potential new crop for the Southeast, were 74% greater in nonirrigated plots treated with fenamiphos and low fertility than yields from similar irrigated treatments. Risk efficient action thresholds have been developed for lesion nematodes on corn. The GLEAMS model (Groundwater Loading Effects of Agricultural Management Systems) was modified to simulate the generation and degradation of pesticide metabolites. GLEAMS-simulated mass of fenamiphos, f. sulfoxide, and f. sulfone in the rhizosphere compared favorably with field data within the variability of observed data. Results from a field test to determine the efficacy of fenamiphos (73.1% in propylene glycol) mixed with Terpine (Unitrol 90) in a 1:1 ratio and fenamiphos (3 SC) applied at 3.3 and 6.6 kg/ha through an irrigation simulator with 0.62 cm of water indicated that lower dosages of fenamiphos and different formulations may provide adequate nematode control, optimum yield, and reduce potential for soil and groundwater pollution.

Publications: 87/01 to 87/12

BURTON, G.W., and JOHNSON, A.W. 1987. Coastal bermudagrass rotations for control of root-knot nematode. J. Nematol. 19:138-140.

JOHNSON, A.W. et al. 1987. The biologic and economic assessment of registered fumigants. USDA Series. 169 pp.

PAYAN, L.A., JOHNSON, A.W., and LITTRELL, R.H. 1987. Effects of nematicides and herbicides alone or combined on Meloidogyne incognita egg hatch and development. Annals of Applied Nematology 1:67-70.

JOHNSON, A.W. et al. 1987. Bibliography of estimated crop losses in the United States due to plant-parasitic nematodes. By: Society of Nematologists Crop Loss Assessment Committee. J. Nematol. 1:6-12.

JOHNSON, A.W. 1987. Nemagation via overhead irrigation. J. Nematol. 19:533. (Abstract).

JOHNSON, A.W., CSINOS, A.S., GLAZE, N.C., and GOLDEN, A.M. 1987. Cochemigation for multiple pest control on tobacco. J. Nematol. 19:533. (Abstract).

JOHNSON, A.W. et al. 1987. Nematicides - A Historical Review. IN J.A. Veech & D.W. Dickson (Eds.) Vistas on Nematology: A Commemoration of the 25th Anniv. of the Soc. of Nematol. pp. 448-454. E.O. Painter Prtg. Co., De Leon Springs, FL.

24.010* CRIS0140217

NEMATODE PATHOLOGY AND MANAGEMENT IN AGRONOMIC CROPS OF THE SOUTHEASTERN COASTAL PLAIN

MINTON N A; Nematodes, Weeds & Crops Research Unit; Agricultural Research Service, Tifton, **GEORGIA** 31794.

Proj. No.: 6602-24000-006-00D

Project Type: INHOUSE

Agency ID: ARS Period: 25 JUN 85 to 25 JUN 90

Objectives: To develop principles and practices of nematode control and management systems for agronomic crops that are economical, energy efficient, and environmentally safe and integrate them with other pest management practices for conventional and conservation tillage systems.

Approach: Maximize nematode control in agronomic crops using resistance rotations, multiple cropping, tillage and chemicals. Determine the interaction of nematodes with other pests in conservation tillage and multiple cropping and integrate with control of other pests to minimize use of chemicals and improve production. Assay soil at different levels in profile to determine rate of nematicide degredation and movement. Utilize laboratory,greenhouse, and field experiments. Obtain population densities of nematodes, fungi and insects, root damage indices, plant vigor ratings, stand counts, plant growth measurements, yield, and product quality. Collect data on peanut for developing peanut production models.

Progress: 87/01 to 87/12. In a double-crop minimum till (MT) experiment, peanut yields were the same following wheat and winter fallow. Moldboard plowed (MBP) plots produced 19% more and % sound mature kernels was greater than in plots planted by the subsoil-plant (SP) method. The nematode Meloidogyne arenaria and the fungus Sclerotium rolfsii were more severe in SP plots than in MBP plots. Also, Temik (3.4 kg ai/ha), the soil fungicide SN84364 (2.2 kg ai/ha), and the combination increased yields 14%, 52% and 81%, respectively. Two formulations of methyl bromide applied without tarp reduced M. arenaria damage and increased peanut yields. The greatest increase of 823 kg/ha occurred for Terr-O-Cide (67 kg ai/ha). Temik (1.7 kg ai/ha) applied postplant to the methyl bromide treated plots increased yields an average of 672 kg/ha. A proprietary nematicide, F5145, reduced M. arenaria damage and increased peanut yields at two rates: 4.9 kg ai/ha, 738 kg/ha and 7.4 kg/ha, 659 kg/ha. Yield differences were not significant when soybean was planted by the SP method in rye stubble and in fallow soil infested with M. incognita. However, cultivar yields were different and Temik (3.4 kg ai/ha) increased yields 61.5%. Host tests and morphological features of a Meloidogyne incognita isolate were not typical for any previously described M. incognita race. Improved nematode, disease and insect control in MT and conventional tillage will increase profits and/or reduce soil erosion which will benefit the producer and consumer.

Publications: 87/01 to 87/12

MINTON, N.A., GOLOEN, A.M., and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.

MINTON, N.A., LEONARD, R.A., and PARKER, M.B. 1987. Concentration of phenamiphos in the profile of a sandy loam soil as affected by tillage and time. J. Nematol. 19:544. (Abstract).

MINTON, N.A., and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. J. Nematol. 19:38-43.

SUMNER, D.R., and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

24.011* CRIS0090950

NEMATODE PATHOLOGY, RESISTANCE AND CONTROL ON FIELD AND FORAGE CROPS

MINTON N A; Plant Pathology; Georgia Coastal Plain Expt Sta, Tifton, **GEORGIA** 31794.
Proj. No.: GEO-02-0218 Project Type: STATE
Agency ID: SAES Period: 01 NOV 83 to 31 OCT 87

Objectives: Study the pathology caused by nematodes and associated organisms infecting plants and integrate nematode controls that may include resistant varieties, chemicals, and cultural practices into systems for control of other pests consistent with cultural practices that minimize the use of chemicals and energy, maximice soil conservation, and improves per unit production.

Approach: Field experiments involving multiple cropping, resistant varieties, winter legumes, cultural practices, and chemicals will be conducted to develop systems of pest control. Greenhouse experiments to determine the interaction of nematodes with other organisms and to evaluate germplasm for nematode resistance will be conducted.

Progress: 83/11 to 87/10. Pratylenchus safaensis was reported in the U.S. (GA) and Meloidogyne graminicola in GA for the first time. Internal stem discoloration in Cobb soybean was more severe in soil infested with Fusarium oxysporum f. sp. tracheiphilum race 1, Belonolaimus longicaudatus and P. brachyurus than with only the fungus. Nematodes (M. arenaria, P. brachyurus), white mold (Sclerotium rolfsii), and insects of peanuts double-cropped after wheat were managed equally well in minimum-tiled (MT) and moldboard plowed (MB) soil. Yields in 9 experiments were increased an average of 5.5% by a nematicide and 13.3% by a soil fungicide + insecticide and MB plots yielded 7.8% more than MT plots. Numbers of M. incognita in soybean were greater in fallowed than in rye plots, but soybean yields were the same. Soybean yields were greater in MT than in MB plots. Ethylene dibromide reduced numbers of nematodes and increased yields more consistently than did aldicarb and phenamiphos. Crimson clover preceeding irrigated corn planted MT had little effect on M. incognita and Paratrichodorus minor. Phenamiphos at 2.8 kg ai/ha increased corn yields 16%. Hoplolaimus columbus populations were high under crimson clover, hairy vetch, common vetch and rye than in fallowed plots; phenamiphos 2.0 kg ai/ha did not control this nematode in corn planted MT and MB. Soil preparation (MT and MB) in rye stubble had little effect on phenamiphos in the soil profile up to 22 weeks after treatment.

Publications: 83/11 to 87/10

MINTON, N.A. 1986. Impact of conservation tillage on nematode populations. Journal of Nematology 18:135-140.
MINTON, N.A. and CSINDS, A.S. 1986. Effects of row spacings and seeding rates of peanut on nematodes and incidence of southern stem rot. Nematropica 16:167-176.
MINTON, N.A., GDLDEN, A.M. and TUCKER, E.T. 1987. First report of Meloidogyne graminicola in Georgia. Plant Disease 71:376.
MINTON, N.A. and PARKER, M.B. 1987. Root-knot nematode management and yield of soybean as affected by winter cover crops, tillage systems, and nematicides. Journal of Nematology 19:38-43.
SUMNER, D.R. and MINTON, N.A. 1987. Interaction of Fusarium wilt and nematodes in Cobb soybean. Plant Disease 71:20-23.

24.012* CRIS0133862
IMPROVING NEMATODE MANAGEMENT IN AGRONOMIC CROPS

MINTON N A; Plant Pathology; Georgia Coastal Plain Expt Sta, Tifton, **GEORGIA** 31794.
Proj. No.: GED-02-0232 Project Type: STATE
Agency ID: SAES Period: 01 NOV 87 to 31 OCT 92

Objectives: To develop principles and practices of nematode management for agronomic crops and integrate them with other pest management practices to result in economical, energy efficient, and environmentally safe production systems for conventional and conservation tillage.

Approach: Resistant cultivars, rotations, multiple cropping, tillage and chemicals will be utilized. Determine the interaction of nematodes with other pests and integrate nematode control with control of other pests to minimize the use of chemicls and improve production. Field, greenhouse and laboratory experiments will be utilized. Dbtain population densities of nematodes, fungi and insects, root damage evaluations, plant vigor ratings, plant stands, plant growth measurements, yield and product quality.

24.013* CRIS0070699
DAMAGE POTENTIAL AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03546 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Elucidate damage potential of nematodes, especially variable races of Meloidogyne incognita (MI) and M. Arenaria; determine impact of environment on related damage to tobacco and soybean; characterize spatial and temporal populations of nematode; develop and evaluate control tactics; monitor nematode communities species changes; and integrate information on MI on soybean into a simulator.

Approach: Field and microplot experiments will focus on "determinants" involved in nematode-induced crop losses. Evaluate utility of "nematode hazard indices" and economic thresholds. Incorporate data on soybean responses to MI into "CIPM" model. Study biochemical basis of differential virulence and resistance to Meloidogyne spp. on tobacco and mechanisms of nematode suppression of nodulation on soybean. Use findings to improve sampling procedures for advisory purposes. Direct cooperative research toward improving control tactics.

Progress: 87/01 to 87/12. Meloidogyne arenaria (MA) caused more severe damage to peanuts than M. hapla in an interaction study in microplots. Populations of MA differed in their virulence on tobacco. This species, M. hapla, and M. javanica had slight to no effect on the activity of M. incognita (MI) on resistant tobacco. Greenhouse evaluations showed a number of "USDA" tobacco lines to have resistance to one or more of these nematodes. These four root-knot species were found to have differential sensitivity to certain nematicides. Moisture levels affected MI-induced gall development on tobacco as well as leaf growth. Young plants and feeder roots of older Asparagus were found to be susceptible to this nematode. Older roots of this host apparently are resistant to MI. Sphaeronema sasseri and Pratylenchus macrostylus were widespread on Fraser fir and red spruce in the Black Mountains, NC. Both nematode species have low temperature optima.

Publications: 87/01 to 87/12

BARKER, K. R. 1987. Effects of irrigation and cultivar on growth and yield response of tobacco to aldicarb. J. Nematol. 19:511 (Abstr.).
BARKER, K. R., and NOE, J. P. 1987. Establishing and using threshold population levels. In Vistas on Nematology, p.75-81. Veech, J.A., and D.W. Dickson (eds.). Society of Nematologists. E. O. Painter Printing Co., FL.
BARKER, K. R., and NOE, J. P. 1987. Techniques in quantitative nematology, p. 223-236 In Experimental techniques in plant disease epidemiology. Kranz, J., and J. Rotem, eds. Springer-Verlag Berlin. Heidelberg-New York.
BARKER, K. R., STARR, J. L., and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.
CABANILLAS, H. E. 1987. Factors influencing the efficacy of Paecilomyces lilacinus in biocontrol of Meloidogyne incognita on tomato. Ph.D. Thesis, NCSU, Raleigh, N.C. 208 p.
KO, M. P. P.-Y, HUANG, J.-S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83: 229-305.

SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

24.014* CRIS0131690
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

STARR J L; Plant Pathology & Microbiology; Texas A&M University, College Station, **TEXAS** 77843.
Proj. No.: TEX07121 Project Type: HATCH
Agency ID: CSRS Period: 08 MAY 87 to 30 SEP 91

Objectives: 1. To elucidate changes in behavior of nematodes resulting from crop manipulation.

Approach: Field microplots will be infested with a population of race 3, race 4, or both of M. incognita. A rotation system of cotton, sorghum, and resistant soybeans will be imposed on each plot. After each growing season several single egg mass isolates from each treatment will be collected and increased on tomato. Resulting populations will be race typed to determine rates of change in race status, if any. In arid regions various skip row planting systems are sued to conserve limited soil moisture. The use of a precision planting system, whereby rows to be planted are always placed over rows fallowed the previous year, will be tested to determine possible benefits in nematode control.

Progress: 87/05 to 87/12. This is a newly established regional project and few studies are yet complete; current project activities are centered on two approaches to management of root-knot nematodes. The first approach is a cultural method whereby skip-row planting systems used to conserve soil moisture in arid regions will be exploited to suppress nematode populations. Long-term (3 yr) experiments have been established to examine the benefit of planting only over rows fallowed the previous year in the skip-row planting system. The other approach to management is the development of root-knot resistant cultivars in crops that are attractive as rotational crops for soybean. Peanut is naturally resistant to soybean cyst nematodes and Meloidogyne javanica and M. incognita. If resistance to M. hapla and M. arenaris can be incorporated into acceptible peanut cultivars, then peanut would be an acceptable rotational crop for soybean. We have begun screening exotic Arachis species germplasm for useful sources of resistance to M. arenaria and M. hapla.

Publications: 87/05 to 87/12

WIGGERS, R., STARR, J.L. and PRICE, H.J. 1987. DNA content of Meloidogyne - induced giant cell nuclei. J. Nematol. 19:562 (Abstr.).
WHEELER, T.A. and STARR, J.L. 1988. Incidence and economic importance of plant-parasitic nematodes on peanuts in Texas. Plant Science:In press.

26.001* CRIS0098677
NONCHEMICAL MEANS OF REDUCING PLANT DISEASES CAUSED BY NEMATODES AND NEMATODE-FUNGUS INTERACTIONS

LA MDNDIA J A; Plant Pathology & Ecology; Connecticut Agri Expt Station, New Haven, **CONNECTICUT** 06504.
Proj. No.: CDNH00686 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 86 to 30 JUN 90

Objectives: To reduce diseases of strawberry and tobacco by nonchemical means through an understanding of the biology and ecology of nematode-fungus interactions. Determine whether Pratylenchus penetrans and Rhizoctonia fragariae interact synergistically to cause black root rot of strawberry. Determine whether synergism between Globodera tabacum and Fusarium oxysporum f. sp. nicotianae increases wilt of broadleaf tobacco. Determine the threshold populations of each pathogen to assess whether management of either the nematode or the fungus alone can reduce disease. Determine whether manipulating soil organic matter and the carbon to nitrogen ratio can decrease nematode numbers through predation and increase competition between nonpathogenic and pathogenic Fusaria and Rhizoctonia.

Approach: The effect of different population levels of nematodes and fungi on disease incidence will be studied in factorial experiments using a split-root design in the laboratory and microplots in the field. Nematodes and fungi will be added singly or together to either or both halves of a split-root system or to microplots to determine threshold populations and the nature of pathogen interactions. Drganic amendments that differ in carbon to nitrogen ratio and that have been inoculated with avirulent Fusarium spp. will be added to soils either previously infested or inoculated later with virulent F. oxysporum. Studies of competition between these fungi will utilize genetically marked isolates.

Progress: 87/01 to 87/12. The tobacco cyst nematode, Globodera tabacum, increased the incidence and severity of wilt caused by Fusarium oxysporum on both MD and CT tobacco. Experiments in the greenhouse and in field microplots indicate that F. oxysporum densities of 10 to 10 CFU per cm soil are necessary to approach 100% disease incidence. G. tabacum populations above 10 juveniles per cm soil increased disease at low fungal densities. Resistance to G. tabacum has been identified in 2 flue-cured tobacco lines. Resistant plants stimulate nematode hatch but allow few nematodes to develop & reproduce, resulting in 70 to 80% population decline in the field and greenhouse. In a survey of CT strawberry fields infested with binucleate Rhizoctonia spp., severe root rot symptoms were associated with the presence of lesion nematodes, Pratylenchus penetrans. P. penetrans root infection increased root rot caused by 3 isolates of binucleate Rhizoctonia (AG A,G & I) and decreased total root length. A greenhouse test of host efficiency indicated that rotating to oats or pumpkins could decrease nematode densities compared to growing continuous strawberries. Nitrate reductase deficient-mutants of F. oxysporum pathogenic to asparagus were obtained. The vegetative compatibilities of these isolates were found to be very diverse. Thus, any soil inhabiting Fusaria may cause disease even when crowns are grown in areas not previously planted to asparagus.

Publications: 87/01 to 87/12
LA MDNDIA, J.A. 1987. Interactions between the tobacco cyst nematode and Fusarium wilt in Connecticut broadleaf tobacco. Phytopathology 77(1):119 (Abstract).
LA MDNDIA, J.A. and TAYLDR, G.S. 1987. Influence of the Tobacco Cyst Nematode (Globodera tabacum) on Fusarium Wilt of Connecticut Broadlfeaf Tobacco. Plant Disease 71:1129-1132.

26.002 CRIS0133754
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

LA MDNDIA J A; Plant Pathology & Ecology; Connecticut Agri Expt Station, New Haven, **CONNECTICUT** 06504.
Proj. No.: CDNH00691 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: The relation between G. tabacum population density at planting and the yield of shade tobacco will be determined in field microplots over several years. Single tobacco plants, isolated in 30-liter microplots, will be grown according to commercial practices in the midst of a shade tent. Each microplot will be inoculated with different densities of encysted juveniles of G. tabacum. Leaves will be sequentially harvested from individual plants in each microplot according to commercial practices.

Approach: These data will allow us to determine the threshold nematode density, and to examine the relationship between yield and increasing nematode numbers above this threshold density. A predictive model of G. tabacum population dynamics will be developed using a simulation model based on G. tabacum life cycle parameters determined from field, greenhouse and growth chamber studies.

26.003 0139748
DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

LA MDNDIA J A; Plant Pathology & Ecology; Connecticut Agri Expt Station, New Haven, **CONNECTICUT** 06504.
Proj. No.: CDNH00695 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Develop improved management tactics for plant parasitic nematodes emphasizing

biological and cultural control procedures.

Approach: Field microplots will be used to determine tobacco yield losses associated with the tobacco cyst nematode, Globodera tabacum. Individual plant yields from plots with a wide range of initial nematode densities will be used to establish nematode damage thresholds over several years. Nematode population changes in microplots and laboratory studies of G. tabacum life cycle parameters will also result in the development of a predictive population dynamics model. This model will reduce the effort associated with monitoring tobacco cyst nematode field populations. Tobacco resistance to G. tabacum will be transferred to Connecticut tobacco types by crossing them with resistany flue-cured tobacco. The inheritance of this resistance will be determined by segregation of progeny for nematode resistance. The mechanism of resistance will be examined by histological studies of nematode infected plant roots.

26.004* CRIS0096487
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

RICH J R; Agricultural Research Center, Live Oak, **FLORIDA** 32060.
Proj. No.: FLA-LIO-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 88

Objectives: To investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with agronomic crops in Florida, and to evaluate methods of nematode disease management.

Approach: Determine the nematode species associated with agronomic crops. Investigate their life cycle activities, their host range, influence of environmental factors on the nematode and on the nematode-host relationship. Test the efficacy of nematicidal chemicals in field studies and evaluate according to yield, phytotoxic effects and nematode population dynamics. Evaluate the nematode management potential of non-chemical practices such as crop rotations, resistant cultivars, and cultivation techniques.

Progress: 86/10 to 87/09. Twenty-eight accessions of pigeonpea were obtained from various parts of the world including India, Puerto Rico, Honduras, and Haiti. Greenhouse tests were initiated to determine relative resistance or tolerance of these accessions to Meliodogyne javanica and M. incognita. Individual plants in 150 cc containers were inoculated with 1500 eggs each of M. javanica or M. incognita. Sixty-five days after inoculation, number of egg masses, and root galling was determined. Of the accesions inoculated with M. javanica, 11 of the 28 exhibited no egg mass production or root galling. Twenty-five accessions of the 28 accessions inoculated with M. incognita exhibited no galling or egg mass production. Test data indicated a range of responses from susceptibility to immunity in pigeonpea to the two nematode species. Further tests under field conditions are necessary to confirm these observations.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

26.005* CRIS0098453
MANAGING ROOT-KNOT DISEASES WITH A NONFUMIGANT NEMATICIDE AND BIOCONTROL AGENTS

DICKSON D W; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02447
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUN 84 to 31 DEC 85

Objectives: Using tobacco and soybean as crop model system we propose to determine, 1) the separate effects of ethoprop in combination with Paecilomyces lilacinus and Bacillus penetrans, 2) the combination effects of P. lilacinus and B. penetrans on M. javanica, 3) whether the nematicide has any adverse effect on P. lilacinus or B. penetrans, and 4) the tolerance of P. lilacinus to high field soil temperature.

Approach: Microplots and naturally infected field soil will be treated with suspensions of P. lilacinus, B. penetrans or combination of the two. Heat treated rice seeds will be added to microplots receiving P. lilacinus. Two separate experiments will be conducted. One will be carried out on the Agronomy Farm, Gainesville and the second will be conducted at the Agriculture Research Center, Live Oak.

Progress: 88/01 to 88/12. The Efficacy of the nematode parasite Paecilomyces lilacinus, alone and in combination with phenamiphos and ethoprop, for controlling the root-knot nematode Meloidogyne javanica on tobacco and the ability of this fungus to colonize in soil under field conditions were evaluated for 2 years in microplots. Combinations and individual treatments of the fungus grown on autoclaved wheat seed, M. javanica eggs (76,000 per plot), and nematicides were applied to specified microplots at the time of transplanting tobacco the first year. Vetch was planted as a winter cover crop, and the fungus and nematicides were applied again the second year to specified plots at transplanting time. The fungus did not control the nematode in either year of these experiments. The average root-gall index (0=no visible galls and 5=>100 galls per root system) ranged from 2.7 to 3.9 the first year and from 4.3 to 5.0 the second in nematode-infested plots treated with nematicides. Plants with M. javanica alone or in combination with P. lilacinus had galling indices of 5.0 both years; and the latter produced lower yields than all other treatments during both years of the study. Nevertheless, the average soil population densities of P. lilacinus remained high, ranging from 1.2 to 1.3 x 10 propagules/g soil 1 week after the initial inoculation and from 1.6 to 2.3 x 10 propagules/g soil at harvest the second year.

Publications: 88/01 to 88/12
HEWLETT, T.E., DICKSON, D.W., MITCHELL, D.J. and KANNWISCHER-MITCHELL, M.E. 1988. Evaluation of Paecilomyces lilacinus as a biocontrol agent of Meloidogyne javanica on tobacco. J. Nematology 20:578-584.

26.006* CRIS0096489
BIOLOGY AND MANAGEMENT OF NEMATODES AFFECTING AGRONOMIC CROPS

DICKSON D W; DUNN R A; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02238 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Investigate the biology and host-parasite relationships of phytoparasitic nematodes associated with field corn, peanut, soybean, and forage crops grown in Florida, and to design and evaluate management strategies to reduce economic losses on these crops.

Approach: The population dynamics and economic damage levels of Pratylenchus brachyurus and Mel Meloidogyne arenaria on peanut and P. brachyurus and Paratrichodorus sp. on corn will be established. The efficacy of fumigant and nonfumigant nematicides for management of nemas on peanut and corn will be investigated. A crop rotation management scheme will be evaluated for managing M. arenaria on peanut. The population dynamics of nemas in minimum tillage-multicropping systems will be monitored. Host-parasite relationships and economic damage relationships of Meloidogyne spp. to soybeans and of various nematodes including Belonolaimus spp. and Meloidogyne spp. to forage crops will be investigated. In cooperative efforts with plant breeders, germ plasm of forage crops, primarily legumes, will be screened for reactions to Meloidogyne spp.

Progress: 87/10 to 88/09. Three tests were conducted to evaluate the efficacy of fumigant and nonfumigant nematicides for control of Meloidogyne arenaria race 1 on peanut. Methyl bromide, 1, 3-D, methyl isothiocyanate, methyl isothiocyanate mixtures, aldicarb, ethoprop, fenamiphos, and F5145 were evaluated by different methods of application preplant, at plant or at early flowering. Of the 32 treatments evaluated, only seven resulted in yield increases (P = 0.05) although early season vigor was high in all treated plots. During the latter one-third of the growing season, however, nematode control was not adequate in most treatments resulting in heavy peg, pod, and root infection by M. arenaria. Four populations of Pratylenchus brachyurus were tested in a greenhouse on selected plant species to determine host suitability and usefulness inidentifying physiological races of the nematode. The differential plants were alfalfa, snap bean, citrus, corn, peanut, soybean, and tomato. Fresh shoot or root weights of plants inoculated with all populations were similar to each other and to the uninoculated control in both experiments. The numbers recovered from snap bean were different (P = 0.05) between populations in each test and from soybean in the second test. The differences between populations on snap bean were different in 2 tests. The effect of two cropping and tillage systems on the population dynamics of 4 nematode species was evaluated.

Publications: 87/10 to 88/09
PAYAN, L.A. and DICKSON, D.W. 1988. Host specificity of four populations of Pratylenchus brachyurus. Ann. Appl. Nematol. 2 'in press'.
GALLAHER, R.N., DICKESON, D.W., CORELLA, J.F. and HEWLETT, T.E. 1988. Tillage and multiple cropping systems and population dynamics of phytoparasitic nematodes. Ann. Appl. Nematol. 2 'in press'.
DICKSON, D.W. and HEWLETT, T.E. 1987. Effect of two nonfumigant nematicides on corn grown in two adjacent fields infested with different nematodes. Ann. Appl. Nematol. 1:89-93.
DICKSON, D.W. and MCSORLEY, R. 1987. Standarization of nematicide application rates. Ann. Appl. Nematol. 1:1-5.
DICKSON, D.W. 1984. Cultural control of nematodes. Pp. 40-45. United States Department of Agriculture, Agricultural Research Service. Nematology Workshop. Oct. 15-18.

26.007* CRIS0092658
BIOLOGICAL CONTROL OF PLANT PARASITIC NEMATODES AND OF INSECTS BY ENTOMOGENOUS NEMATODES

SMART G C JR; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02433 Project Type: STATE
Agency ID: SAES Period: 06 MAR 84 to 31 DEC 88

Objectives: To evaluate organisms such as fungi, bacteria and antagonistic plants as biological control agents of plant parasitic nematodes. To evaluate entomogenous nematodes as biological control agents of noxious insects.

Approach: The fungus, Paecilomyces lilacinus, will be used in experiments to control the root-knot nematode, Meloidogyne incognita. The fungus will be used alone and in conjunction with the bacterial spore parasite, Bacillus penetrans. B. penetrans also will be used alone. Other fungi and other nematodes may be used in future experiments. Antagonistic plants to be used are the digitgrasses, Pangola digitgrass initially against M. incognita and Transvala digitgrass against the sting nematode, Belonolaimus longicaudatus. Initial research will be with Neoaplectana carpocapsae against the mole crickets Scapteriscus acletus and S. vicinus.

Progress: 87/10 to 88/09. For more than three years after release of a Neoaplectana sp. (formerly called N. carpocapsae = Steinernema) from Uruguay in three small (50 m2) plots, the nematode is still causing about a 10% infection of mole crickets. The nematode has spread from the release sites (at least 5 miles after three years), and mole cricket populations, as

measured by capture of nymphs in pitfall traps, has gone from an average of 93 lymphs before treatment to 16 one year later to 6 after two years and to 4 after three years. Damage to the grass has decreased. When placed on the soil surface or just under it, the infective-stage juveniles moved downward 10 cm, infected and killed mole crickets in dishes below. They moved downward as readily outdoors in field soil as in containers of soil in the laboratory, and in fact, killed mole crickets more efficiently in the field with a concentration of nematodes 5 times less than in the laboratory. When placed in the center of a soil column, the nematodes moved both upward and downward 8 cm with a greater number moving down than up. Infective-stage juveniles were buried in the soil in tightly sealed containers or in containers covered with 10 um Nitex cloth. In both types of containers the nematodes survived and were able to kill mole crickets after the 8 or 10 weeks of the tests. Even though the numbers that survive are reduced rapidly during the first week, numbers decline much more gradually during subsequent weeks.

Publications: 87/10 to 88/09

OLEXA, M.T. and SMART, G.C., JR. 1987. Pesticides and public employee liability. Journal of Nematology 19:549 (Abstr.).

GERBER, K., SMART, G.C. and ESSER, R.P. 1987. A comprehensive catalog of plant parasitic nematodes associated with aquatic and wetland plants. Bulletin 871 (Technical) 170 pp. Agric. Expt. Sta., IFAS, Univ. Fla., Gainesville.

NGUYEN, K.B. and SMART, G.C., JR. 1988. Mode of entry of neoaplectanid nematodes into mole crickets. Soil and Crop Science Society of Florida, Proceedings 47:250 (Abstr.).

26.008 - 0145259
SIMULATION OF PLANT-PEST INTERACTIONS

SELTMANN H; SCHNEIDER S M; Agricultural Research Service, Oxford, **NORTH CAROLINA** 27565.

Proj. No.: 6647-61000-003-00D
Project Type: INHOUSE
Agency ID: ARS Period: 03 MAY 89 to 02 MAY 94

Objectives: Develop a computer model of tobacco plant growth and a model of the root-knot nematode life-cycle based on rates of penetration, development and reproduction. Dynamically link the plant and nematode models to create a realistic crop production model to predict yield and quality.

Approach: Develop and test computer models using field, greenhouse and growth chamber data. The model will be process-oriented and written in FORTRAN or PASCAL. Plant processes will include photosynthesis, respiration, carbon partitioning, flower initiation, and water and nutrient uptake. Quantify hatch, penetration, development, and reproduction of root-knot nematodes on susceptible and resistant tobacco cultivars and incorporate data into nematode model. Quantify impact of nematode population on plant processes. Collect field databases by destructively sampling at bi-weekly intervals. Measurements will include plant height, leaf number, and fresh weight, dry weight, surface area and chemical composition of each leaf position. Environmental conditions will be continuously monitored using automatic recording equipment.

Progress: 89/05 to 89/12. A model of soybean cyst nematode was written in PASCAL on a microcomputer. The life cycle was divided into 4 functional stages; egg, infective juvenile, parasitic juvenile, adult. An Erlang function was used to describe probability of maturation in developmental stages. The transition from infective to parasitic juvenile, penetration of root and establishment of feeding site, was described by a negative exponential function. A field was inoculated with Meloidogyne incognita & planted to susceptible (NC2326) & resistant (K399) tobacco. A database consisting of weather & plant growth characteristics measured at bi-weekly intervals was developed. A slight yield reduction, but an increased quality of cured leaf of NC2326, was observed with low levels of root-knot. A field test was initiated to determine impact of inoculum placement on onset and severity of black shank (Phytophthora parasitica) on 3 tobacco cultivars (Hicks, K326, G28). Wet weather delayed inoculation & resulted in serious insect & disease losses other than those caused by black shank. The spatial distribution of tobacco root system was investigated by excavating 15 cm3 blocks of soil & extracting roots at bi-weekly intervals. A database consisting of weather & root fresh weight, dry weight, & length in each soil cube was constructed. Yield & quality of cured leaf was not affected by girdling after topping, but a reduction in percent alkaloids was observed. Results reaffirm the influence of top on alkaloids.

Publications: 89/05 to 89/12

SCHNEIDER, S.M. 1989. Probs assoc with life cycle studies of a soil-inhabiting organism. pp. 156-166. IN McDonald, Manly, Lockwood, Logan (eds.) Est & anal of insect pops. Springer-Verlag, Berlin.

SELTMANN, H., SHEETS, T.J., CAMPBELL, C.R. and QUICK, F.E. 1989. Chemical residues and agronomic characteristics of flue-cured tobacco after applications of 2,4-D and dicamba. Tob. Sci. 191. Accepted August 1, 1989.

SCHNEIDER, S.M., SCHMITT, D.P. and BARKER, K.R. 1989. Modeling the life cycle and damage potential of soybean cyst nematode. Proc. 12th Ann. Work on Crop Sim. Abstr. p. 20.

SCHNEIDER, S.M., SCHMITT, D.P. and BARKER, K.R. 1989. A distributed development model of soybean cyst nematode. J. Nematol. Abstr. 21 587.

WHEELER, T.A., BARKER, K.R. and SCHNEIDER, S.M. 1989. Effect of soil moisture on development of Meloidogyne incognita and related tobacco growth. J. Nematol. Abstr. 21 595.

WHEELER, T.A., BARKER, K.R. and SCHNEIDER, S.M. 1989. Tobacco growth as affected by Meloidogyne incognita and soil moisture. Phytopath. Abstr. 79 1135.

26.009 CRIS0140523
DEVELOP TECHNIQUES FOR THE GENETIC MODIFICATION OF TOBACCO FOR IMPROVED PRODUCTIVITY QUALITY & SAFETY

SISSON V A; SPURR H W; Tobacco Safety - Gen, Bio & Ch Tobacco Research Laboratory; Agricultural Research Service, Oxford, **NORTH CAROLINA** 27565.
Proj. No.: 6647-22420-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 85 to 30 SEP 90

Objectives: Develop knowledge and techniques for genetic modification of tobacco and other crop plants. Identify genetic systems that control resistance to pests, improve safety, utility, growth, and other important plant characteristics. Develop basic germplasm with novel characters.

Approach: Conduct comprehensive genetic programs on the development of germplasm through intra and interspecific transfer of desirable factors using conventional and emerging genetic techniques, such as tissue culture and other biotechnologies. The tobacco plant will be used to enhance basic knowledge which may apply to the improvement of other crop plants as well as tobacco. Develop improved germplasm for health related constituents as well as other chemical, physical, morphological, quality, growth, and pest resistance characteristics. Identify genetic variability for selected treatments, make controlled hybridizations, and conduct genetic analysis todetermine the inheritance of a given trait and select experiments to introduce the traits into an acceptable genetic background.

Progress: 87/01 to 87/12. A tobacco germplasm release, I514, was made in 1987. This germplasm is from a cross of TI 165 by NC 82 and is characterized by less damage from tobacco budworm due to lower survival and less larval growth. This may facilitate the development of tobacco cultivars that require less insecticides. Germplasm enhancement programs are underway to reduce phenol production, reduce number and weight of suckers, combine sources of resistance to bacterial wilt, and to develop nematode resistance especially to the M. arenaria and M. javanica species. Resistance to Potato Virus Y (PVY) has successfully been transferred from a cigar type cultivar Havana 307, into a flue-cured germplasm background. Resistant lines were selected from a population of anther-derived doubled haploids. Several of these doubled haploid lines were also found to be highly resistant to tobacco etch virus (TEV). Efforts to identify genetic markers in tobacco have been successful in finding variation in the alcohol dehydrogenase isozyme system of tobacco. Two variant types exist. A single band pattern which comigrates with the single band of N. sylvestris, one of the progenitor species, and a three band zymogram identical to the pattern produced by the allopolyploid between N. sylvestris and N. tomentosiformis. Results confirm the dimeric inheritance of the genes coding for this enzyme.

Publications: 87/01 to 87/12
GWYNN, G.R., SNOOK, M.E., WILLIAMSON, R.E., and SCHLOTZHAUER, W.S. 1987. Genetics and breeding of total and constituent polyphenols of Nicotiana tabacum. 41st TCRC:40. (Abstract).
SISSON, V.A. 1987. Genetic control of alcohol dehydrogenase isozymes in Nicotiana tabacum. 1987 Agronomy Abstracts:79.

26.010* CRIS0070699
DAMAGE POTENTIAL AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03546 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Elucidate damage potential of nematodes, especially variable races of Meloidogyne incognita (MI) and M. Arenaria; determine impact of environment on related damage to tobacco and soybean; characterize spatial and temporal populations of nematode; develop and evaluate control tactics; monitor nematode communities species changes; and integrate information on MI on soybean into a simulator.

Approach: Field and microplot experiments will focus on "determinants" involved in nematode-induced crop losses. Evaluate utility of "nematode hazard indices" and economic thresholds. Incorporate data on soybean responses to MI into "CIPM" model. Study biochemical basis of differential virulence and resistance to Meloidogyne spp. on tobacco and mechanisms of nematode suppression of nodulation on soybean. Use findings to improve sampling procedures for advisory purposes. Direct cooperative research toward improving control tactics.

Progress: 87/01 to 87/12. Meloidogyne arenaria (MA) caused more severe damage to peanuts than M. hapla in an interaction study in microplots. Populations of MA differed in their virulence on tobacco. This species, M. hapla, and M. javanica had slight to no effect on the activity of M. incognita (MI) on resistant tobacco. Greenhouse evaluations showed a number of "USDA" tobacco lines to have resistance to one or more of these nematodes. These four root-knot species were found to have differential sensitivity to certain nematicides. Moisture levels affected MI-induced gall development on tobacco as well as leaf growth. Young plants and feeder roots of older Asparagus were found to be susceptible to this nematode. Older roots of this host apparently are resistant to MI. Sphaeronema sasseri and Pratylenchus macrostylus were widespread on Fraser fir and red spruce in the Black Mountains, NC. Both nematode species have low temperature optima.

Publications: 87/01 to 87/12
BARKER, K. R. 1987. Effects of irrigation and cultivar on growth and yield response of tobacco to aldicarb. J. Nematol. 19:511

(Abstr.).
BARKER, K. R., and NOE, J. P. 1987. Establishing and using threshold population levels. In Vistas on Nematology, p.75-81. Veech, J.A., and D.W. Dickson (eds.). Society of Nematologists. E. O. Painter Printing Co., FL.
BARKER, K. R., and NOE, J. P. 1987. Techniques in quantitative nematology, p. 223-236 In Experimental techniques in plant disease epidemiology. Kranz, J., and J. Rotem, eds. Springer-Verlag Berlin. Heidelberg-New York.
BARKER, K. R., STARR, J. L., and SCHMITT, D. P. 1987. Usefulness of egg assays in nematode population density determinations. J. Nematol. 19:130-134.
CABANILLAS, H. E. 1987. Factors influencing the efficacy of Paecilomyces lilacinus in biocontrol of Meloidogyne incognita on tomato. Ph.D. Thesis, NCSU, Raleigh, N.C. 208 p.
KO, M. P. P.-Y, HUANG, J.-S., and BARKER, K. R. 1987. The occurrence of phytoferritin and its relationship to effectiveness of soybean nodules. Plant Physiol. 83: 229-305.
SCHMITT, D. P., FERRIS, H., and BARKER, K. R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

26.011 0138711
ECOLOGY, PHYSIOLOGY, AND MANAGEMENT OF PLANT-PARASITIC NEMATODES

BARKER K R; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC06099 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Develop and improve management tactics for Meloidogyne species and races; characterize the interactions of selected nematodes and their hosts as affected by the environment, especially soil texture, nutrients, moisture, and selected microflora; develop and refine models that characterize the dynamic interactions of Meloidogyne incognita on tobacco, and Heterodera glycines as affected by nematode levels and environment.

Approach: Experiments designed to fulfill the objectives shall be conducted in the greenhouse, laboratory, microplots, and in the field. Management tactics will emphasize cropping systems, biocontrol, resistance, and nematicides. Studies on environmental parameters will focus on their effects on nematode activity (reproduction, survival), and interactions with hosts. Host physiological processes under study include water utilization, photosynthesis, nitrogen metabolism, and mechanisms of resistance to nematodes. Major collaboration research components include those on resistance, nematicides, physiology, and modeling.

26.012 CRIS0133441
MODELLING INTERACTIONS BETWEEN PLANTS AND PESTS

SCHNEIDER S M; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC05638 Project Type: STATE
Agency ID: SAES Period: 01 OCT 86 to 30 SEP 91

Objectives: Develop computer models describing the dynamic, physiological interaction between plants and pests such as nematodes, viruses, fungi, bacteria, insects, and weeds. Develop techniques to measure the goodness-of-fit of the models.

Approach: Obtain or develop physiological process oriented plant models. Obtain or develop pest population models. In cooperation with other scientists, determine the impact of the pest on the physiology of the plant and the influence of the host plant on the development of the pest. Describe the interaction between plant and pest quantitatively. Use mathematical descriptions to dynamically link the plant model and pest model.

Progress: 87/01 to 87/12. The dynamic modelling of plant/pest interactions requires plant and pest models and a model of the interaction between the two. Field data was collected for development and validation of a tobacco growth model. Weekly measurements of NC2326 and K399 included leaf length, width, surface area, fresh and dry weight, alkaloid, sugar, starch, and nitrogen concentrations. Environmental variables include air and soil temperature, rainfall/irrigation, and solar radiation. Work on the rootknot nematode/tobacco interaction has concentrated on penetration and development of two rootknot nematode species on two commercial tobacco varieties. NC2326 is susceptible to Meloidogyne incognita (Mi), Meloidogyne arenaria (Ma), and Meloidogyne javanica (Mj). K399 was bred for resistance to Mi. Results showed that numbers of Mi and Ma observed in the roots of NC2326 steadily increased from days 1 to 14 after inoculation. Numbers of Mj observed in the NC2326 were not consistent. Numbers of Mi and Ma in K399, were greater than those in NC2326 at 4 days, but by 14 days the numbers of Mi and Ma were 54% and 71% less than those found in NC2326. Final populations of Mj were similar in the NC2326 and K399. These results indicate that K399 has some resistance to Ma and that the nematode is capable of penetrating the resistant variety, but leaves the root when a functional feeding site cannot be established.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

26.013 CRIS0097057
BIOLOGICAL CONTROL OF CERTAIN FOLIAR PLANT DISEASES AND NEMATODES IN TOBACCO

SPURR H W; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC05615 Project Type: STATE
Agency ID: SAES Period: 01 OCT 85 to 30 SEP 90

Objectives: Manage microflora to control foliar plant disease and nematodes. Determine how to induce resistance in plants to disease.

Approach: Identify bacterial strains from leaf microflora and other sources which antagonize fungal pathogens. Develop practical production, formulation and application systems for using bacterial antagonists to control pathogens. Develop models to guide and assist biological control research. Identify agents which induce host resistance to disease. Refine methods for studying nematodes to evaluate bacterial strains as potential biological control agents for nematodes.

Progress: 87/01 to 87/12. A computer simulation model was developed to predict disease progression of Cercospora leaf spot of peanut (causal agents: Cercospora arachidicola and Cercosporidium personatum). The model was derived in part from an advisory system used for fungicide scheduling in North Carolina and Virginia. Basic infection rate was modeled as a function of hours of relative humidity >95%, minimum temperature during the period of high humidity, amount of infected tissue, and proportion of uninfected tissue remaining. Latent and infectious periods were treated as distributed delay processes, and host plant growth (increase in leaflet number) was described as a logistic process. The model was validated using independent weather and disease severity data from field trials with peanut cultivar Florigiant, in which C. arachidicola was the predominant pathogen. Simulated disease progress curves and periods of rapid disease increase were similar to those observed in field trials. The model effectively ranked four epidemics in terms of end-of-season disease severity and area under the disease progress curve.

Publications: 87/01 to 87/12

KNUDSEN, G. R. and SPURR, H. W., JR. 1987. Field persistance and efficacy of five bacterial preparations for control of peanut leaf spot. Plant Disease 71:442-445.

TRIGIANO, R. N. and SPURR, H. W., JR. 1987. The development of the multinucleate condition of Peronospora tabacina. Mycologia 79:353-357.

KNUDSEN, G. R., SPURR, H. W., JR. and JOHNSON, C. S. 1987. A computer simulation model for Cercospora Leafspot of Peanut. Phytopathology 77:1118-1121.

26.014* CRIS0088272

TAXONOMIC STUDIES IN THE NEMATODE SUPERFAMILY HETERODEROIDEA

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC03798 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 82 to 30 SEP 87

Objectives: Clarify taxonomic relationships of selected species groups of the superfamily Heteroderoidea based on comparative morphology. Determine usefulness of serology for the taxomy of Meloidogyne spp. Find out whether anatomical modifications of the reproductive system of Meloidogyne spp. have occurred together with the cytogenic evolution (amphimixis to meiotic and mitotic parthenogenesis).

Approach: Compare the external and internal morphology of all life stages of the Meloidogyne incognita and M. arenaria species complexes, certain Meloidogyne spp. groups from grasses and coffee, as well as the Heterodera trifolii species complex, and males of certain Heteroderidae using light and scanning electron microscopy. Compare serologically several Meloidogyne spp. and their races using Ouchterlony double diffusion and immunoelectrophoresis. Compare the fine structure of the reproductive system of Meloidogyne species with amphimictic, meiotic and mitotic parthenogenetic reproduction.

Progress: 82/10 to 87/09. An extensive comparative morphological study using light microscopy and scanning electron microscopy was made of the most common cytological and host races of Meloidogyne arenaria and M. incognita species complexes. A number of new, useful differentiating characters were identified in second-stage juveniles, males and females, and the morphological limits of these species were defined. Each species included several variant populations. M. arenaria exhibited more extensive intraspecific variation than M. incognita. Physiological differences existing between the host races were not expressed morphologically. The taxonomic placement of Hypsoperine spartinae in the genus Meloidogyne was re-evaluated based on morphological and cytogenetic characteristics. Three new Meloidogyne species were described: M. microcephala, M. hispanica, and M. mayaguensis. A technique was developed to excise nematode copulatory structures (spicules and gubernacula), and their morphology was examined using SEM. Fourteen members of Heteroderoidea and 12 other plant-parasitic, insect- parasitic and free-living nematodes were compared. Although spicule shape was diagnostic in several of the species examined, only slight differences were detected in spicule morphology among heteroderoid nematodes.

Publications: 82/10 to 87/09

RAMMAH, A., and HIRSCHMANN, H. 1987. Morphological comparison and taxonomic utility of copulatory structures of selected nematode species. J. Nematol. 19:314-323.

RAMMAH, A., and HIRSCHMANN, H. Meloidogyne mayaguensis n. sp. (Meloidogynidae), a root-knot nematode from Puerto Rico. J. Nematol. (In Press).

26.015* CRIS0132029

MORPHOLOGICAL AND TAXONOMIC STUDIES IN THE NEMATODE FAMILY MELOIDOGYNIDAE

TRIANTAPHYLLOU H H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC06013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: Elucidate the taxonomic relationships of major Meloidogyne species and determine the extent of morphological variation within each species. Compare general anatomy and fine structure of the reproductive system of various cytogenetic forms of root-knot nematodes in an effort to clarify their phylogeny.

Approach: Compare by LM and SEM all life stages of the Meloidogyne incognita and M. arenaria species complexes and certain Meloidogyne species from grasses and coffee. Study inter- and intraspecific variation and evaluate qualitative and quantitative characters statistically. Emend original species descriptions and describe new taxa. Make a comparative study of the fine structure of the reproductive system of Meloidogyne species with different modes of reproduction.

26.016* CRIS0131089
DISTRIBUTION, ECOLOGY AND PATHOGENICITY OF ROOT-KNOT NEMATODE (MELOIDOGYNE SPP.)

LEWIS S A; Plant Pathology & Physiology; Clemson University, Clemson, **SOUTH CAROLINA** 29634.
Proj. No.: SC01225 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 87 to 30 MAR 92

Objectives: Determine the subspecific identity of geographical isolates of Meloidogyne spp. in soybean, cotton, and tobacco; determine environmental and edaphic conditions under which physiologic development is favored; and evaluate various host and nonhost plants for nematode management in potential cropping systems.

Approach: Geographical isolates of Meloidogyne incognita and M. arenaria will be identified using host differential plants, perineal patterns of females, male lip shape, cytology, and esterase enzyme profiles. Soil structure, moisture, and temperature relationships will be assessed for their importance in reproduction and aggressiveness of several M. incognita isolates. Life tables will be constructed after determining activity and developmental thresholds of the isolates. Physical and moisture characteristics of two soils will be studied for their influence on egg hatch, movement, invasion, and reproduction. The host suitability of different cultivars of corn, wheat, and sorghum will be assessed against selected isolates of M. incognita. Mass screening of nematode isolates and plant cultivars will be done in the greenhouse and field. This information will be used to develop an economic model of root-knot nematode management.

Progress: 87/04 to 87/12. Greenhouse and laboratory experiments were performed to determine if an interaction exists between Meloidogyne incognita and Hoplolaimus columbus on Davis soybean. Greenhouse tests were performed with three population levels of M. incognita and H. columbus (0, 15,00, 6,000/1.5-liter pot) separately and in all combinations. Dry root weight (DRT) declined nonlinearly and dry shoot weight (DST) declined linearly with respect to increasing initial populations of M. incognita and H. columbus. When the two nematode species were added to the soil together, the amount of DRT and DST suppression by one species was dependent on the initial level of the concomitant species. The final root population of M. incognita or H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus declined linearly with increasing initial population density of the concomitant species. H. columbus suppressed M. incognita populations in the soil nonlinearly, but M. incognita had no effect on H. columbus. In other tests, using root explants of M. incognita-susceptible Davis and M. incognita-resistant Centennial, roots parasitized by M. incognita are more attractive to H. columbus than roots of susceptible, and especially M. incognita-resistant soybean ccultivars infected by H. columbus. In susceptible Davis, H. columbus is not only attracted to M. incognita-infected roots but also penetrates these roots more readily than noninfected roots.

Publications: 87/04 to 87/12
GUY, D.W., JR. and LEWIS, S.A. 1987. Selective migration and root penetration by Meloidogyne incognita and Hopololaimus columbus on soybean roots in vitro. J. Nematol. 19:390-392.
GUY, D.W., JR. and LEWIS, S.A. 1987. Interaction between Meloidogyne incognita and Hopolaimus columbus on Davis soybean. J. Nematol. 19:346-351.

26.017 CRIS0090340
BREEDING DISEASE AND NEMATODE RESISTANT FLUE-CURED TOBACCO FOR YIELD, QUALITY AND HARVESTABILITY

CURRIN R E; Agronomy & Soils; Pee Dee Res & Educ Center, Florence, **SOUTH CAROLINA** 29501.
Proj. No.: SC01054 Project Type: STATE
Agency ID: SAES Period: 01 JUL 83 to 30 JUN 88

Objectives: To develop varieties of flue-cured tobacco (Nicotiana tabacum L.) that have multiple resistance to major diseases with better yield and quality. To identify tobacco lines having resistance to the peanut root-knot nematode (Meloidogyne arenaria). To evaluate varieties and breeding lines with satisfactory yield and quality for mechanical harvesting.

Approach: Identification of cultivars having resistance to M. arenaria will be conducted in the greenhouse using a pure culture of M. arenaria. Tobacco introductions, released varieties and advanced breeding lines will be screened. When resistance and mode of inheritance has been determined, suitable plant breeding techniques will be employed to transfer resistance to varieties of acceptable yield and quality. Genetically stable breeding lines developed from the program as outlined for disease resistance will be visually evaluated for uniform ripening, leaf shape,

size, stalk strength and leaf holding ability. Those lines which appear superior will in turn be grown in randomized, replicated field experiments and harvested under simulated mechanical procedures.

Progress: 87/01 to 87/12. Seventy-four dihaploids were evaluated in a randomized, replicated trial in CY 87. These dihaploids were derived fromcrosses of T.I.'s and Flue-Cured Varieties and were another derived - weights ranged from 453 to 2441 kg. ha. Grade index ranged from 26 to 50. It was noted that generally those lines with poorer yields also had a poorer grade index. Samples for chemical analyses were taken but data is not available at this time. Although several of .the dihaploids compared favorably with their flue-cured parents, none were equal or superior in yield or value. These dihaploids were also evaluated in the M. arenaria, black shank and Granville wilt nurseries. Data is not complete at this time. Normal pedigree and backcross techniques are also being used concurrently to develop resistance to M. arenaria.

Publications: 87/01 to 87/12

FLEMING, ROBERT, B., JR. 1987. Screening tobacco introductions for resistance to the root-knot nematode, Meloidogyne arenaria. MS Thesis, Clemson University.

26.018 CRIS0134902
BREEDING DISEASE AND NEMATODE RESISTANT FLUE-CURED TOBACCO

CURRIN R E; Agronomy & Soils; Pee Dee Res & Educ Center, Florence, **SOUTH CAROLINA** 29501.
Proj. No.: SC01275 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 88 to 30 JUN 93

Objectives: To identify tobacco germplasm with resistance to Meloidogyne arenaria and incorporate that resistance into improved cultivars having resistance to the common diseases of tobacco. Develop and select cultivars with the satisfactory yield, quality and disease resistance which are adapted to mechanical harvesting.

Approach: Identification of tobacco germplasm having resistance to M. arenaria will be conducted in the greenhouse using a pure culture of M. arenaria. Tobacco introductions, released varieties and advanced breeding lines will be screened. When resistance and mode of inheritance has been determined, suitable plant breeding techniques will be employed to transfre resistance to varieties of acceptable yield and quality. Genetically stable breeding lines developed from the program as outlined for disease resistance will be visually evaluated for uniform ripening, leaf shape, size, stalk strength and leaf holding ability. Those lines which appear superior will in turn be grown in randomized, replicated field experiments and harvested under simulated mechanical procedures.

26.019 CRIS0093310
TOBACCO DISEASE AND NEMATODE CONTROL

FORTNUM B A; Plant Pathology & Physiology; Pee Dee Res & Educ Center, Florence, **SOUTH CAROLINA** 29501.
Proj. No.: SC01091 Project Type: STATE
Agency ID: SAES Period: 01 JUL 84 to 30 JUN 89

Objectives: Commercial and experimental compounds will be examined for efficacy to control disease. Host plant resistance and crop rotation will be evaluated for the effects on populations of pathogens and disease control. Evaluation of environmental factors such as soil moisture and temperature and the impact on nematode ecology and nematode induced disease expression will be studied.

Approach: Commercial and experimental compounds applied under varying application techniques such as preplant incorporation, transplant water and fumigation will be evaluated in the control of Phytophthora parasitica and Meloidogyne arenaria. Disease resistance ratings will be performed in regional small plot entries for the major diseases in South Carolina. The effect of soil moisture on nematode reproduction and disease expression will be evaluated using measurements such as egg mass production, surface leaf temperatures (infrared thermometry) and diffuse resistance. The effect of temperature and time on nematode overwintering will be evaluated in field plots.

Progress: 87/01 to 87/12. Tobacco varieties entered into the regional small plot tests were grown under controlled disease pressure in the field to evaluate the level of resistance to Phytophthora parasitica var nicotianae and Pseudomonas solancearum. Susceptablity to both diseases varied with the 35 varieties examined. Damage due to P. parasitica was heavy and the percent disease varied with the variety. Loss due to P. solancearum was moderate. A 50/50 ratio of Meloidogyne arenaria and M.incognita was inoculated on tobacco followed by two cycles through a 2-year rotation scheme. The five-year rotation study is in the fifth year. Populations of M. arenaria increased on all varieties of tobacco and soybeans. Tobacco following soybeans and tobacco following tobacco had the lowest yields and the highest root galling index. Cotton, corn, peanuts and clear fallow increased yields over continuous tobacco. Clear fallow increased yields and was comparable to the fumigated control. Preliminary data suggest rotation crops can shift pecies ratios to favor M. incognita or M. arenaria and could be useful in retarding the development of the more virulent species M. arenaria. Root-knot nematodes were applied to tobacco roots in microplots and there effect on plant water stress evaluated. Leaf temperature minus air temperature (triangle T) was used as a measure of transpiration. Irrigation consistently reduced triangle T but root-knot nematodes had no effect on leaf temperature and there was no root-knot nematode-irrigation interaction.

Publications: 87/01 to 87/12

FORTNUM, B.A., KRAUSZ, J. and CURRIN, R.E., III, 1987. A rapid technique for the infestation of field plots with Meloidoggyne spp. J. of Nematology 19:135-137.
FORTNUM, B.A. and CURRIN, R.E., III. 1987. Effect of soil temperature on the development of Meloidogyne arenaria on tobacco. J. of Nematology 19-522.

26.020 0138476
TOBACCO DISEASE AND NEMATODE CONTROL

FORTNUM B A; Plant Pathology & Physiology; Pee Dee Res & Educ Center, Florence, **SOUTH CAROLINA** 29501.
Proj. No.: SC01322 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 89 to 30 JUN 94

Objectives: Crop rotation and nematicides will be evaluated for control of concomitant root-knot nematode populations on flue-cured tobacco. The effects of soil moisture and canopy light quality on root-knot nematode reproduction and disease expression in nematode infested-tobacco will be evaluated. Regional test varieties, experimental compounds, and biocontrol agent will be evaluated for efficacy to control tobacco diseases.

Approach: Rotation crops and selected nematicides, alone and in combination, will be evaluated to assess their influence on concomitant population of Meloidogyne arenaria and M. incognita in a two year tobacco rotation. Meloidogyne spp. composition at harvest will be determined using larval morphometrics, perineal patterns and confirmed with electrophoresis. The influence of soil moisture on root-knot nematodes will be studied in microplots where soil moisture can be controlled. Crop canopy light quality will be altered by varying plant spacing and row orientatin to assess it's effects on plant and nematode development. Pesticides will be evaluated in replicated field plots for control of tobacco diseases present in South Carolina.

Progress: 89/07 to 89/12. Experimental tobacco varieties entered into the regional small plot tests were grown under controlled disease pressure in the field to evaluate the level of resistance to Phytophthora parisitica var nicotianae & Pseudomonas solancearum. Susceptability to both diseases varied with the 32 varieties examined. Rotation crops for use in tobacco production, including cotton, sorghum, wheat-fallow & corn were compared with continuous tobacco when grown in soil infested with Meloidogyne incognita and M. arenaria. Populations of Meloidogyne spp. were lower following all rotation crops when compared to continuous tobacco. Lowest nematode populations were observed following sorghum. The effects of rotating crops & nematicide applications on tobacco yields & nematode species composition has not been completed. Choice of cropping sequence and nematicide application may play a role in the increasing occurance of the more virulent species Meloidogyne arenaria.

Publications: 89/07 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

26.021 CRIS0071244
HOST-PATHOGEN INTERACTIONS AND DISEASE CONTROL IN TOBACCO (NICOTIANA TABACUM L.)

REILLY J J; TERRILL T R; KDMM D A; S Piedmont Res Cntr, Blackstone, **VIRGINIA** 23824.
Proj. No.: VA-2024030-020 Project Type: STATE
Agency ID: SAES Period: 01 DCT 76 to 31 DEC 86

Objectives: To identify resistance to Phytophthora parasitica var. nicotianae (black shank),Thielaviopsis basicola (black root rot), Meloidogyne spp. (root knot), Globodera solanacearum (tobacco cyst nematode), and certain viruses; to study the disease inciting agents of tobacco, their interactions, and control. Specifically, to investigate the interaction between black shank fungus and tobacco cyst nematode, and tobacco mosaic virus and Polymyxa graminis; To study the epidemiology of disease development with initial emphasis on the epidemiology of black shank.

Approach: Three methods of controlling plant diseases in tobacco will be utilized; Resistance: Cooperation in the development of resistant varieties by screening breeding lines for resistance to major regional and local diseases. Lines are grown in greenhouses, exposed to pathogens, and rated; -disruption of the pathogen life cycle by studying the epidemmiology and ecology of pathogens and the interaction of pathogens in disease complexes under field conditions in order to effect long term, environmentally safe control measures, -chemicals control by testing formulations and application methods utilizing labeled and experimental chemicals.

Progress: 86/01 to 87/09. Isolates of Thielaviopsis basicola from 3 burley tobacco fields induced more root rot and stunting in greenhouse tests than did isolates from 4 Virginia flue-cured tobacco fields. Seedlings of 3 burley tobacco cultivars without N. debneyi resistance appeared to be more tolerant of black root rot than the 4 flue-cured tobacco cultivars tested. Nineteen nematicide treatments were also evaluated for efficacy against a tobacco cyst nematode (TCN), Globodera tabacum solanacearum. None proved more effective against TCN than the standard (Nemacur). However, several treatments involving combinations of smaller quantities of Nemacur with other nematicides provided equivalent control for a reduced estimated cost. Use of a TCN-resistant cultivar (NC 567) with Nemacur in 1984 and 1985 resulted in lower pre-plant TCN population densities in 1985 and 1986. No effect was observed on TCN population densities at the end of the 1985 and 1986 growing seasons from planting a TCN-resistant versus a susceptible cultivar in 1984 and/or 1985. Alternating use of TCN-resistant versus TCN-susceptible cultivars on a two-year rotation plan did not increase yield or economic returns significantly. However, use of a TCN-resistant cultivar with Nemacur for two

years, followed by planting a TCN-susceptible but high yielding, high quality cultivar, produced the highest yield and economic return in 1986. No effects of using TCN-resistant versus susceptible cultivars were found on grade index or average price.

Publications: 86/01 to 87/09

JOHNSON, C. S., 1987, Pathogenicity of 7 Virginia isolates of Thielaviopsis basicola on selected burley and flue-cured tobacco cultivars., Phytopathology (Abstr.) 77:987.

27.001* CRIS0028875
NEMATODE POPULATION MANAGEMENT IN MICHIGAN CROP PRODUCTION

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL00446 Project Type: STATE
Agency ID: SAES Period: 20 AUG 82 to 19 AUG 88

Objectives: To develop procedures for improved detection of nematodes (plant parasitic and beneficial) and diagnosis of nematode problems associated with selected fruit, vegetable and agronomic crop production systems. To develop procedures for improved production system analysis related to nematode problems; with special reference to nematode sampling and extraction and crop loss assessment. To design and validate integrated nematode management procedures using the principles of exclusion, population reduction and tolerance.

Approach: Most of the research associated with this project will deal with three model nematode species: Pratylenchus penetrans, Meloidogyne hapla and Heterodera schachtii. Xiphinema americanum, Longidorus breviannulatus, Criconemella xenoplax, Heterodera trifolii and Meloiodgyne nataliei will be investigated on a more limited basis. Field, greenhouse, growth chamber and laboratory experiments will be used to design improved nematode sampling, extraction and crop loss assessment procedures. A broad array of nematode control procedures will be validated under both field and controlled conditions.

Progress: 87/01 to 87/12. The 1987 research program concentrated on management of nematode problems of carrot, potato, cherry, sugarbeet, soybeans and corn. Heterodera glycines was discovered in Michigan for the first time, and the geographical isolate will attack dry beans. Implementation of previous chemigation research continue to be successful. In a jount MSU project with the Zimbabwe Ministry of Agriculture, maize roots and P. zeae were aggregated at depth 0-20 cm. P. zeae in this study had a Pf/Pi ratio of 170. Very few second stage juveniles were recovered in this study. The optimal time for sampling maize roots for P. zeae was 4 weeks after planting at depth 10-20 cm and radius of 0-10 cm. The optimal time for sampling soil around maize roots was 2 weeks after planting at depth 10-20 cm and radius 10-20 cm. Maize root growth was adversely impacted at 11.7% gravimetric soil moisture in loamy sand soil and P. zeae population density was only slightly adversely impacted at 5.0% gravimetric soil moisture in the greenhouse study. Carbofuran, fenamiphos, isazofos and terbufos reduced P. zeae in maize roots by 95, 96, 95 and 93% and increased yield by 67, 54, 37 and 66% respectively, and organic amendments reduced P. zeae and increased maize growth and grain yield.

Publications: 87/01 to 87/12

MACGUIDWIN, A.E., BIRD, G.W., HAYNES, D.L. and GAGE, S.H. 1987. Pathogenicity and population dynamics of Meloidogyne hapla associated with Allium cepa. Pl. Dis. 71:446-449.

MUCHENA, P.K. and BIRD, G.W. 1987. Role of fenamiphos as a nemastat for control of Heterodera schachtii in cabbage production. Pl. Dis. 71:552-554.

BURNETT, B. 1986. Effects of the oat cyst nematode on small grains in Michigan. M.S. Thesis. Crop and Soil Science Dept. MSU. E. Lansing. 63 pp.

27.002* CRIS0143085
MANAGEMENT OF ROOT-FEEDING WEEVILS AND WHITE GRUBS OF CITRUS/SUGARCANE WITH ENTOMOGENOUS NEMATODES

SCHROEDER W J; SOSA O; Agricultural Research Service, Orlando, **FLORIDA** 32804.
Proj. No.: 0500-21010-001-76D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 88 to 30 SEP 91

Objectives: Use entomogenous nematodes to manage soil insects under field conditions. Maximize nematode efficacy through timing of application and release rate. Assess impact of entomogenous nematodes on citrus/sugarcane soil insects. Develop application techniques that can be utilized by industry. Establishindustry cost benefit data. Implement control practices.

Approach: Survey citrus/sugarcane to identify insect-infested fields. Sample soils for presence of endemic entomogenous nematodes. Treat candidate groves and sugarcane fields with an inundative release of entomogenous nematodes. Sample treated groves and fields for nematode population presence. Determine impact of nematode populations on crop yield by comparison of treated and control plots.

27.003* CRIS0131303
IDENTIFICATION, BIOLOGY, AND MANAGEMENT OF AGRICULTURALLY IMPORTANT PLANT PARASITIC NEMATODES

MCGAWLEY E C; Plant Pathology & Crop Physiol; Louisiana State University, Baton Rouge, **LOUISIANA** 70803.
Proj. No.: LAB02587 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 SEP 91

Objectives: To identify nematode genera, species, and races parasitic on major Louisiana crop plants. To evaluate the influence of other major plant pest groups on nematode population ecology and pathogenicity. To investigate methods useful in reducing nematode-related plant injury.

Approach: Nematode survey, greenhouse host differential testing for nematode race identification, light microscopy of nematode and plant characteristics. Field plot experiments, microplot research. Laboratory, greenhouse, and field experimentation with natural and synthetic nematicides.

Progress: 87/01 to 87/12. In numerical order, with the frequency of detection indicated in parentheses immediately after, the distribution of the five known races of the Soybean Cyst Nematode (as represented by 162 soil samples collected from the 13 major soybean producing parishes) in Louisiana is as follows: race 1 (7); race 2 (24); race 3 (68); race 4 (30); race 5 (15) and, questionable race (18). Results of greenhouse studies conducted to assess the interaction or lack thereof between the Soybean Cyst Nematode and the Red Crown Rot disease pathogen, Calonectria crotalariae, indicates that the reproduction f each organism is augmented in the presence of the other. Disease effects are additive. Penetrsation of root tissues of cyst nematode resistant plants is significantly increased when it is infected with the fungus. Race 2 of Meloidogyne incognita (Mi-2) is the most common one associated with soybeans in Louisiana. Cultivars which contain resistance to this nematode are available. Cultivars with resistance to Mi-2, but which are severely galled have been observed under field conditions with increasing frequency during the last two years. These cultivars contain both Mi-2 and M. iavanica.

Publications: 87/01 to 87/12

DVERSTREET, C. and MCGAWLEY, E.C. 1987. Influence of Calonectria crotalariae on reproduction of Heterodera glycines on resistant and susceptible soybeans. Journal of Nematology. (In press).

RUSSIN, J.S., LAYTDN, M.B., BDETHEL, D.J., MCGAWLEY, E.C. SNOW, J.P. and BERGGREN, G.T. 1987. Interactions of Heterodera glycines with Diaporthe phaseolorum var. caulivora and insect-induced defoliation on soybean.

RUSSIN, J.S., LAYTDN, M.B., MCGAWLEY, E.C. BDETHEL, D.J. and SNDW, J.P. 1987. Interactions between soybean looper, stem canker fungus, and soybean cust nematode on soybean. Phytopathology 77: (In Press).

LAYTDN, M.B., RUSSIN, J.S., MCGAWLEY, BDETHEL, D.J., BERGGREN, G.T. and SNDW, J.P. 1987. Effects of insect-induced defoliation, stem canker disease, and soybean cyst nematode on soybean growth and N(2) fixation.

MCGAWLEY, E.C. and WINCHELL, K.L. 1987. Greenhouse reproduction of single and combined Meloidogyne incognita and M. javanica on soybean. Journal of Nematology 19: (In Press).

27.004* CRISO132230

CONTROL OF HETERODERA SCHACHTII AND CERCOSPORA BETICOLA ON SUGAR BEET IN THE NEBRASKA PANHANDLE

KERR E D; Panhandle Station; University of Nebraska, Lincoln, **NEBRASKA** 68583.
Proj. No.: NEB-44-036 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 87 to 30 JUN 92

Objectives: 1. Determination of the relationship between the cyst and egg counts, respectively, and yield loss associated with the sugar beet cyst nematode for western Nebraska. 2. Development of a sugar beet cercospora leaf spot alert system for western Nebraska. 3. Develop cultural and chemical control measures for diseases of major field and vegetable crops in western Nebraska.

Approach: 1. The number of cysts and eggs of Heterodera schachtii in preplant soil samples will be determined. Paired plots will be established with nematicide treatment and no treatment in areas of a field with a wide range of nematode populations. Root & sugar yield at harvest will be compared to initial cyst & egg populations. Economic threshold levels of nematode populations will be determined for advisory use with growers. 2. Sugar beet Cercospora leaf spot infection will be monitored & compared to periods of leaf wetness, relative humidity, & temperature. Periods favorable for infection will be used to establish fungicide advisories for growers. 3. Fungicides & nematicides will be tested in field plots for efficacy in control of sugar beet nematode & false root-knot nematode on sugar beet, lesion nematode on corn, Rhizoctonia root rot on sugar beet, Botrytis blight on onion, and powdery mildew on sugar beet.

Progress: 87/01 to 87/12. An advisory system for application of fungicides to control Cercospora leaf spot on sugar beet was field tested in western Nebraska in 1986 and 1987. Daily infection values (DIV's) were based on Minnesota/North Dakota systems using duration of relative humidity (RH) >90% and mean air temperature. DIV's were determined in this test using duration of leaf wetness and mean canopy temperature derived from sensors on an automated weather station placed in a sugar beet field with a history of severe leaf spot and also from RH >90% and mean air temperatures derived from a hygrothermograph placed in the same location. DIV's favorable for infection were recorded from July 24-August 3 by leaf wetness and canopy temperatures and only on July 31 and August 8 using RH >90% and air temperatures. A test plot on the same location was used to compare fungicide applications starting with favorable DIV's from the two methods and with first leaf spot symptoms. All fungicide treatments were followed by significantly (0.05 level) less leaf spot than an untreated control but differences among fungicide treatments were not significant. Sugar yield was greater from fungicide treated plots than from control plots but the difference was not significant. Hail injury altered yield level and disease severity. Disease severity was very low, as expected from the weather data, and severity did not increase during periods of unfavorable DIV's.

Publications: 87/01 to 87/12

ND PUBLICATIDNS REPDRTED THIS PERIDD.

27.005* CRIS0057100
EVALUATION OF NEMATODE CONTROL PRACTICES IN CROPS OF ECONOMIC IMPORTANCE

ORAMAS D; ACOSTA N; ROMAN J; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTO RICO** 00927.
Proj. No.: PR00247 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 28 FEB 93

Objectives: To evaluate nematicides, alone and concurrently with cultural, physical and biological selected control practices potentially effective for the control of nematodes affecting crops of economic importance in Puerto Rico.

Approach: Preliminary greenhouse tests will be conducted to select effective nematicides and rates and to evaluate, whenever necessary, selected control practices. The most promising treatments will be tested in the field to determine effects on yield and quality, residue levels and phytotoxicity. Field evaluation will be conducted at different sites and will include nematicide treatments alone and concurrently with cultural, physical and biological selected control practices. The evaluation criteria will be nematode population before, after treatments and at harvesting; commodity yield and quality; cost and earning of the treatments; residues in commodities; persistance in the soil; hazard to humans and toxicity to mammals and plants.

Progress: 87/01 to 87/12. Liquid formulations of fenamiphos, carbofuran and fensulfothion were applied alone and in combination with their granular counterparts (butylfos and carbofuran) as soil treatments in yams. Temik 10G as standard and oxamyl 24L as a check were used for comparison. The trial is underway and data are not available yet. A field experiment was conducted to determine the efficacy of terrazole, thiabendazole and aldicarb, alone and in-combinations on the control of fungi and nematodes in plantains. They were not effective against root rot. Significant yeild differences over the control were obtained in nematicide-treated plots, regardless of fungicide treatment. Fruit weight was significantly higher in watermelon plots treated with Paecilomyces lilacinus fungus 2 weeks before planting and in carbofuran-treated plots ad compared to control ones. Significant differences in yield over the control were obtained with applications of carbofuran at 2.24 and 4.48 kg/ha. Three cucumber varieties were evaluated as to root knot nematode resistance at the Isabela Substation. There were no significant differences in yields between cultivars Dasher II and Poinsett 76, but the first one was significantly most resistant than cultivar Geminis 7. Eighteen pumpkin lines were evaluated in the greenhouse as to resistance to M. incognita but only DR-14 and DR-11 were moderately resistant. A survey of 25 commercial farms showed that R. reniformis was the most common nematode associated with papaya.

Publications: 87/01 to 87/12

ECHAVEZ-BADEL, R. 1987. Evaluacion preliminar de la resistencia del pepinillo al nematodo nodulador. Memorias Sociedad Puertorriquena de Ciecias Agricolas, Gurabo, P.R., Nov. 13, p. 21 (Abstr.).
NEGRON, J. and ACOSTA, N. 1987. Studies on host-parasite relationships of Meloidogyne incognita and Coffea arabica cv. Borbon. Nematropica 17(1):71-78.
ORAMAS, D. and ROMAN, J. 1987. Cambios histologicos inducidos en la raiz del platano (Musa acuminata x M. balbisiana, AAB) por 4 especies de nematodos de importancia economica en Puerto Rico.
VICENTE, N., ABREU, E. and MEDINA-GAUD, S. 1987. Chemical control of Meloidogyne incognita, Rotylenchulus reniformis and Anthonomus eugenii in Capsicum annuum and C. frutescens. Nematropica 17(2):163-69.

28.001 CRIS0027025
PLANT GERMPLASM INTRODUCTION, INCREASE, EVALUATION, DOCUMENTATION, MAINTENANCE AND DISTRIBUTION

MORELOCK T E; Horticulture & Forestry; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK00687 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To introduce useful plant germplasm through foreign and domestic plant exploration for agricultural, industrial, and urban-rural uses; to evaluate introduced and domestic plant materials and to maintain and publish records of their performance and use in the Southern Region.

Approach: The project leader will canvas crop scientists of the station each year for needs that might be met through foreign or domestic exploration and will submit requests in prescribed form; introduced materials of interest to Arkansas scientists will be made available to them by circulating descriptive material, and obtaining for them any requested accessions.

Progress: 87/01 to 87/12. High levels of resistance to Rhizoctonia root rot have been incorporated into white seeded bush type green beans by using PI 165426 (black seeded) and Venezuela 54 to cross with commercial cultivars. A number of individual plants in 8 Lycopersicon peruvianum accessions showed resistance to spotted wilt. Screening of L. pimpinellifolium accessions is continuing. James McD. Stewart - Taxonomic treatment of 1985 Gossypium collections from the Kimberley region of Western Australia is near completion and descriptions and illustrations of 5 new species are in progress. We have concluded that a supposedly well known taxon (G. populifolium) is misidentified. This problem is being studied and may result in an additional new species. Seed of each of the accessions of the Kimberly Gossypium have been germinated and seedlings are now growing of all but one accession. That accession is lost because of immature seed. Seed of all the accessions of Asiatic cottons in the US germplasm collection were obtained and plants are being grown in the field of all accessions that had viable seed. The objective is to verify accession labels (many errors as to species ID are involved), obtain description information and voucher specimens, and increase seed numbers for a multiple screening project. The screening project is designed to locate in the asiatic cottons resistance to seedling disease, root-knot nematodes, thrips, plant bugs, Heliothis, and boll weevil.

Publications: 87/01 to 87/12
ENDERS, C.S. and LONGER, D.E. 1987. Herbicide selectivity among grain and weedy amaranthug species. Agronomy Journal (In press).
PATERSON, R.G., SCOTT, S.J. and GERGERICH, R. 1987. Epidemiology and genetic resistance in tomato-to-tomato spotted wilt virus in Arkansas. HortScience (In press) abstract.

28.002 CRIS0034365
DESICCATION OF ENTOMOGENOUS NEMATODES FOR LONG-TERM MASS STORAGE

POPIEL I; Biosis, Palo Alto, **CALIFORNIA** 94303.
Proj. No.: CALK-8702560 Project Type: SMALL BUSINESS GRANT
Agency ID: SBIR Period: 15 SEP 87 to 30 SEP 89

Objectives: To develop a biochemical quality control test for successful induction of anhydrobiosis. To determine efficiency of nutrient reserve conservation in anhydrobiotic IJs and predict long term storage potential. To define the dynamics of water loss that IJs can tolerate. To determine the parameter limits for a pilot plant scale desiccation process. To determine the oxygen requirements of IJs during and after induction of anhydrobiosis. To extend shelf life evaluations begun in Phase I. To design and evaluate packaging systems for long term storage of desiccated IJs.

Approach: Our approach will be to determine the upper and lower limits for the rate and extent of water loss that will result in successful induction of anhydrobiosis. We will then use these data as the basis for process parameter determination. Data on nutrient reserve conservation will enable us to predict nematode shelf life. Package design will be based on oxygen demand.

28.003* CRIS0095489
THE NEMATODE COMPONENT OF ROOT DISEASE-SOIL INSECT COMPLEXES OF FIELD CROPS

MELTON T A; Plant Pathology; 1301 West Gregory Drive, Urbana, **ILLINOIS** 61801.
Proj. No.: ILLU-68-0363 Project Type: HATCH
Agency ID: CSRS Period: 01 MAY 85 to 30 SEP 88

Objectives: Determine the interrelationships of nematodes and their population dynamics with other soil biological factors, soil types, corn and legume yields, cropping sequences, host genotypes, and economic thresholds and integrate results into crop protection models for corn and legume crops.

Approach: A sequential approach will be used. Various combinations of biotic and abiotic factors first will be tested under controlled conditions of the greenhouse to determine their interrelationships with nematode populations. Significant interactions will be studied further under semicontrolled conditions such as in microplots, where soil biotic factors will remain controlled but natural climate and edaphic factors may influence results. Models will be created or updated to reflect new data. Finally, multiple testing of models will be conducted under field conditions, where all biotic and abiotic factors can interrelate.

Progress: 86/10 to 87/09. Greenhouse studies using F2 isogenic lines of Oh 43 (normal DIMBOA), Oh 43 bx (low DIMBOA), A632, A632 (low OMBOA), and the inbreds C 123 (excellent host), bx/bx (very low OIMBOA), and BX/BX (high

DIMBOA) showed differences (P=0.05) in host suitabilities for Pratylenchus scribneri. Low DIMBOA lines were good hosts, whereas normal or high DIMBOA lines were poor hosts. P.scribneri populations on A632 bx and Oh43 bx were more than ten times the size of the A632 and Oh43 populations. Based on orthogonal contrasts these differences were highly significant (P=0.005). Other inbreds are being tested as well as possible mode of actions of DIMBOA. These results provide a basis for more work to determine if DIMBOA is a major mechanism for resistance of corn to P. scribneri. Because DIMBOA concentration is determined by a single gene, resistance could be incorporated into modern hybrids. The mutant bx/bx has been backcrossed to the F3 generation in A632 and Oh43, and to the F2 generation in B37, Mo17, H99, H60, and LH38. These inbreds will be tested to determine the role of DIMBOA as a mechanism for P. scribneri and P. hexincisus.

Publications: 86/10 to 87/09

MELTON, T.A. and SIMCOX, K.D. 1987. Effects of 2,4-Dihydroxy-7-methoxy-2H 1, 4-benzoxazin-3(4h)-one (DIMBOA) in corn lines on reproduction of Pratylenchus hexincisus. J. Nematology 19:543. (Abstr.).

28.004* CRIS0014770

AUTECOLOGY AND CONTROL OF SOILBORNE PLANT PATHOGENS

GREEN R J JR; Botany & Plant Pathology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IND055013 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To ellucidate the causal factor(s) in the "decline complex" of the peppermint cultivars Mentha piperita cv's Todd's Mitcham and Murray Mitcham. Initiate studies on the biosuppression of the weed species velvetleaf Abutilon theophrasti and the ecology of Verticillium dahliae in relation to this plant species. Make final field evaluations of selected irradiation-induced mutants of scotch spearmint Mentha cardiaca resistant to V. dahliae.

Approach: The causal factor(s) of the decline complex of peppermint Mentha piperita will be identified through isolations from affected plant parts. Greenhouse studies will attempt to duplicate the disease complex by control of soil and other environmental conditions for further study. Field plots will be treated with selective biocides to control known nematodes, insects and microbial pathogens. The population dynamics of propagules of V. dahliae in soil will be followed with velvetleaf Abutilon theophrasti and the subsequent biosuppression of the weed population. Selected mutants of scotch spearmint resistant to V. dahliae will be field tested in IN, MI and WA for final selection, increase and release to growers.

Progress: 87/01 to 87/12. A 3 year study of the causal factors associated with the "decline complex" in old fields of peppermint Mentha piperita cv Murray Mitcham was completed. Decline of roots and overwintering stolons was associated with infection and colonization by, in order of frequency, Fusarium spp. Rhizoctonia solani, Pythium spp. Alternaria spp. and Sphaceloma menthae. There was also a significant increase (P=05) in infection by Verticillium dahliae and the lesion nematode Pratylenchus penetrans. Decline was more severe in previously fumigated plots after 3 years when on-farm rootstocks were used in the original planting compared to disease-free stocks. A survey of 25 peppermint fields 3 years or older selected at random in 3 different areas of IN for incidence and level of populations of P. penetrans showed populations as follows: 0=7 fields; 10-100=4 fields; 100-400=6 fields; 400-800=3 fields; 800-2000=2 fields; 2000-5000=1 field & 5000+=2 fields. Counts were based on ave. nemas/g dry root. Critical levels for crop injury are 2000+/g dry root. Consistent evidence cannot be demonstrated of cross-protection of tomato cvs resistant to Fusarium oxysporum f. sp. lycopersici (FOL) but susceptible to Verticillium dahliae (VD) when inoculated simultaneously with these pathogens. Cvs with either "I" gene or multiple gene resistance to FOL exhibited a different disease response to VD than susceptible cvs regardless of whether simultaneously inoculated with FOL/VD or not.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

28.005 CRIS0142762

PRODUCTION PRACTICES AND MANAGING NEMATODES AND ROOT DISEASES ON KENAF

WEBBER C L; WANN E V; Agricultural Research Service, Lane, **OKLAHOMA** 74701.
Proj. No.: 6222-22240-001-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 FEB 88 to 31 JAN 93

Objectives: Devleop technology to increase productivity of kenaf by improving cultiversand sultural practices including protection from nematodes and soil borne diseases.

Approach: Races of Meloidogyne incognita, the southern root knot nematode, will be screened to identify those which attack kenaf. The severity and nature of damage to kenaf caused by these races will be rated and described. Soilborne pathogens such as Rhizoctonia and Pythium will be similarly investigated. Field trials of kenaf cultivars and germplasm lines will be conducted on various soil types in southeastern Oklahoma to evaluate their ability to escape, resist, or overcome damage from these organisms; assess the influence of soil type on the host-parasite relationships; and determine the overall adaptability of the germplasm to conditions of the region. Based on the results of these investigations, available cultural practices will be evaluated for efficacy in combatting the effects of thesesoilborne organisms. Standard and modified cultural practices, together with selected and developed germplasm lines, will be combined to provide recommended strategies for kenaf production.

28.006* CRIS0066710
QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESSES

INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: ORE00199 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extraction methodology for nematode detection and assessment. Determination of the relationship between crop losses and nematodes as affected by environmental conditions. Determinations of management cost/efficiency functions to allow derivation of economic thresholds.

Approach: Efficiency of nematode extraction from different soil types in Oregon will be compared to between Baermann Funnel, with and without wet sieving, and sucrose centrifugation, with and without wet sieving. The optimum procedure(s) will be compared with elutriation with the help of Dr. Howard Ferris at U.C. Davis. Nematode population dynamics and crop losses to root-knot nematodes will be studied under different irrigation regimes at the Hermiston Experiment Station. Threshold levels for lesion nematodes on mint will be studied in microplot experiments at the Central Oregon Experiment Station. The effect of concommitant infection with Verticillium on these threshold levels will also be examined.

Progress: 87/01 to 87/12. Objective 1: Number of lesion nematodes recovered from Baermann extraction with plastic funnels averaged 15% less than that from glass funnels but this difference was not statistically significant. Objective 2: Soil populations of Meloidogyne chitwoodi second stage juveniles were less in microplots receiving greater than normal amounts of water and greater in microplots receiving less than normal irrigation than in check microplots receiving "normal" levels of water application. Percent tuber infection and number of galls/tuber also decreased with increasing water application. Lesion nematode population growth was not affected by amount of water applied. Objective 3: Individual seed pieces of Russett Burbank Potato were planted (4-16-86) in five gallon microplots infested with 0, 1, 11, 107 or 1069 M. chitwoodi eggs/qt soil. Tubers harvested (9-2-86) from these plants grown under "normal" water application contained 18, 12, 32, 83 or 100% infection with M. chitwoodi respectively. Index of infection on a scale of 0 (no infection) to 6 (100+ gall/tuber) averaged 0.35, 0.25, 0.9, 2.6, and 4.5 respectively. First-year yield of Benton strawberries grown in five-gallon microplots infested with 0, 2,500, 5,000, 10,000 or 20,000 Pratylenchus penetrans averaged 711, 643, 647, 595 or 644 g berries/plant respectively.

Publications: 87/01 to 87/12

SCHROEDER, J.M. 1987. Population dynamics, distribution and control of nematodes in highbush blueberries. M.S. Thesis Oregon State Univ., Corvallis, OR. 97p.

SCHROEDER, J.M., INGHAM, R.E. and GARREN, R. 1987. Population dynamics and control of nematodes in highbush blueberries. Proceedings of the Oregon Horticultural Society 78:153-155.

INGHAM, R.E., SCHROEDER, J.M. and GARREN, R. 1987. Seasonal, vertical and horizontal distribution of plant parasitic nematodes in Oregon highbush blueberry. J. Nematol. 4:531.

28.007* CRIS0098620
IDENTIFICATION, BIOLOGY AND CONTROL OF NEMATODE PESTS IN OREGON AGRICULTURE

INGHAM R E; Botany & Plant Pathology; Oregon State University, Corvallis, **OREGON** 97331.
Proj. No.: ORE00261 Project Type: STATE
Agency ID: SAES Period: 01 JUN 86 to 31 MAY 91

Objectives: Monitor known nematode problems, as well as identify and evaluate potential new problems which may occur as the result of population increases, disease complexes with microbial pathogens or changes in management practices. Research new and existing chemical and management control measures and evaluate their efficacy and cost efficiency for various known nematode pests. Study the biology of plant disease complexes which include nematodes and microbial pathogens.

Approach: A current knowledge of nematode species affecting Oregon agriculture will be maintained by examining samples submitted to the Plant Clinic and by occasional surveys. Chemical control will be examined by treating research plots in growers' fields with new and existing nematicides. Chemicals will be screened for efficacy, phytotoxicity and plant residue. Management practices to be examined include crop rotation sequences and the effects of cover crops on nematode populations in perennial crops. Microplots containing either potatoes or mint will be inoculated with nematodes, Verticillium, both or neither pathogen. Plant growth and yield will be examined for evidence of interactions between the two pathogens.

Progress: 87/01 to 87/12. Vydate 2E at 1 lb ai/A, Mocap 6E at 3 or 6 lb/A and Mocap 10 G at 6 lb/A were evaluated for control of lesion and pin nematodes on peppermint. Treatments were applied on April 15 or 29 to compare efficacy of different treatment dates but nematode densities in almost all treatments were not significantly different between application dates. Soil populations of lesion nematodes on May 28 were significantly less in the Mocap 6E on April 29 treatment than in the control and all other treatments except Mocap 10G on April 29. At harvest (August 3), densities were lowest in the Mocap 6E on april 29 treatment but were only significantly less than densities in the Vydate treatments. On May 28, numbers of pin nematodes were significantly less in the Vydate and Mocap 10G treatments than in the control. However, on August 3 only the April 15 treatment of Vydate had significantly fewer nematodes that in the control. Nemacur 3 at 6 or 12 lb ai/A was evaluated for control of

lesion nematodes on highbush blueberry. The 12 lb ai/A rate significantly reduced lesion nematode populations as compared to the nontreated control but densities were not significantly different from those treated with 6 lb ai/A. Post treatment densities in the 6 and 12 lb ai/A treatments averaged 55% and 5% of those in the nontreated control, respectively.

Publications: 87/01 to 87/12

KAROW, R.S. and INGHAM, R.E. 1986. Cereal cyst nematode (Heterodera avenae Woll.). OSU Crop Science Report, EXT/CRS 66, 5 p.

INGHAM, R.E. 1987. Root-knot nematodes--preventing a potential problem. Proceedings of the 1987 Oregon Potato Conference and Trade Show, pp. 51-55.

28.008* CRIS0057100

EVALUATION OF NEMATODE CONTROL PRACTICES IN CROPS OF ECONOMIC IMPORTANCE

ORAMAS D; ACOSTA N; ROMAN J; Crop Protection; University of Puerto Rico - Mayaguez, Rio Piedras, **PUERTO RICO** 00927.

Proj. No.: PR00247 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 28 FEB 93

Objectives: To evaluate nematicides, alone and concurrently with cultural, physical and biological selected control practices potentially effective for the control of nematodes affecting crops of economic importance in Puerto Rico.

Approach: Preliminary greenhouse tests will be conducted to select effective nematicides and rates and to evaluate, whenever necessary, selected control practices. The most promising treatments will be tested in the field to determine effects on yield and quality, residue levels and phytotoxicity. Field evaluation will be conducted at different sites and will include nematicide treatments alone and concurrently with cultural, physical and biological selected control practices. The evaluation criteria will be nematode population before, after treatments and at harvesting; commodity yield and quality; cost and earning of the treatments; residues in commodities; persistance in the soil; hazard to humans and toxicity to mammals and plants.

Progress: 87/01 to 87/12. Liquid formulations of fenamiphos, carbofuran and fensulfothion were applied alone and in combination with their granular counterparts (butylfos and carbofuran) as soil treatments in yams. Temik 10G as standard and oxamyl 24L as a check were used for comparison. The trial is underway and data are not available yet. A field experiment was conducted to determine the efficacy of terrazole, thiabendazole and aldicarb, alone and in combinations on the control of fungi and nematodes in plantains. They were not effective against root rot. Significant yeild differences over the control were obtained in nematicide-treated plots, regardless of fungicide treatment. Fruit weight was significantly higher in watermelon plots treated with Paecilomyces lilacinus fungus 2 weeks before planting and in carbofuran-treated plots ad compared to control ones. Significant differences in yield over the control were obtained with applications of carbofuran at 2.24 and 4.48 kg/ha. Three cucumber varieties were evaluated as to root knot nematode resistance at the Isabela Substation. There were no significant differences in yields between cultivars Dasher II and Poinsett 76, but the first one was significantly most resistant than cultivar Geminis 7. Eighteen pumpkin lines were evaluated in the greenhouse as to resistance to M. incognita but only DR-14 and DR-11 were moderately resistant. A survey of 25 commercial farms showed that R. reniformis was the most common nematode associated with papaya.

Publications: 87/01 to 87/12

ECHAVEZ-BADEL, R. 1987. Evaluacion preliminar de la resistencia del pepinillo al nematodo nodulador. Memorias Sociedad Puertorriquena de Ciecias Agricolas, Gurabo, P.R., Nov. 13, p. 21 (Abstr.).

NEGRON, J. and ACOSTA, N. 1987. Studies on host-parasite relationships of Meloidogyne incognita and Coffea arabica cv. Borbon. Nematropica 17(1):71-78.

ORAMAS, D. and ROMAN, J. 1987. Cambios histologicos inducidos en la raiz del platano (Musa acuminata x M. balbisiana, AAB) por 4 especies de nematodos de importancia economica en Puerto Rico.

VICENTE, N., ABREU, E. and MEDINA-GAUD, S. 1987. Chemical control of Meloidogyne incognita, Rotylenchulus reniformis and Anthonomus eugenii in Capsicum annuum and C. frutescens. Nematropica 17(2):163-69.

28.009 CRIS0143028

CULTURAL PRACTICES AND GERMPLASM MAINTENANCE OF KENAF

WANN E V; LANGFORD D; Rio Farms Inc, Edcouch, **TEXAS** 78538.

Proj. No.: 6222-22240-001-01S
Project Type: COOPERATIVE AGREE.
Agency ID: ARS Period: 20 APR 88 to 19 APR 89

Objectives: To identify and evaluate the necessary cultural and management practices for commercialization of Kenaf crop production and increase the seed of existing kenaf verieties and germplasm.

Approach: This project will investigate the production potential of kenaf grown for fiber under different cultural regimes. Replicated small-plot field studieswill be used to evaluate relationships between date of planting, cultivar, and harvest timing on yield. Interactions of plant population density and cultivar effects on kenaf growth and yield also will be examined in field trials. Pest status of plant parasitic nematodes and their effects on kenafyield will be investigated in efficacy studies evaluating soil applied nematocides. Kenaf germplasm and cultivar seed increases will be performed in greenhouse and field production plots.

28.010* CRIS0091352
PATHOGENICITY, BIOLOGY AND CONTROL OF ROOT-KNOT NEMATODES ON IRRIGATED CROPS IN WASHINGTON

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP00650 Project Type: HATCH
Agency ID: CSRS Period: 01 SEP 83 to 31 AUG 89

Objectives: Determine pathogenicity, damage and threshold levels; determine biology (population dynamics, vertical distribution, survival, migratory capabilities, life cycle, number of generations, host-parasite relationships, etc); and determine the efficacy of nematicides in relation to timing and application methods for controlling Meloidogyne chitwoodi and M. hapla.

Approach: Pathogenicity, biology and control studies will be conducted under controlled laboratory, greenhouse, field microplots, and/or natural field conditions. Naturally infested fields or pure root-knot nematode populations reared in the lab or greenhouse will be used to measure effects on plants. Soil used in tests will be free of other pathogens, except under natural field conditions. Experiments will be arranged in randomized block designs with 5 or more replicates. Experimental data to be collected will include measurements of crop yield and/or quality, plant growth, dry weight accumulation, nematode population dynamics in soil and plant tissue, and symptom expression. Environmental conditions including soil types, temperatures, moisture levels, length of growing season will be taken into account as they may affect the pathogenicity, biology and control of root-knot nematodes.

Progress: 87/01 to 87/12. Nematicide trials were conducted to evaluate chemicals for the control of Meloidogyne chitwoodi on potatoes. Treatmennts included fumigants and nonfumigants alone and in combinations; post-plant applications of non-fumigants to protect tubers at the time of nematode invasion; multiple applications of nonfumigants; and several application methods and rates were used to evaluate fumigants (Telone II, Vapam) and nonfumigants (Mocap, Nemacur, Temik, Vydate). Chemicals registered for use on potatoes as well as experimental compounds were evaluated. Excellent control was obtained with Telone II; fumigants in combination with Mocap; Mocap and Nemacur applied prior to planting and incorporated; and multiple post-plant applications of Mocap. Damage threshold studies show that M. hapla can reduce top growth of peppermint after two years at initial (Pi) inoculum levels of 500, 1,000, and 5,000 juveniles/250 cm soil. On Scotch spearmint growth reduction was observed at Pi of 5,000.

Publications: 87/01 to 87/12

SANTO, G.S., MOJTAEDI, H., PINKERTON, J.N. and WILSON, J.H. 1987. Biological control of root-knot nematodes on potato, 1987. Proc. of 26th Ann. Wash. State Potato Conf., pp. 57-59.

61.001 0139364
CONTAINMENT, AUGMENTATION AND RELEASE OF EXOTIC BIOCONTROL AGENTS THROUGH QUARANTINE

LITTLEFIELD J L; Entomology; Montana State University, Bozeman, **MONTANA** 59717.
Proj. No.: MONB00164 Project Type: STATE
Agency ID: SAES Period: 01 JUL 88 to 30 JUN 93

Objectives: Contain exotic arthropods and nematodes used for the biological control of pestiferous weeds and insects of regional importance. Remove pathogens, parasites and other organisms from imported materials. Facilitate the importation, augmentation, study and release of biocontrol agents.

Approach: This laboratory will be maintained and kept secured in accordance to USDA-APHIS-PPQ guidelines for quarantine facilities. Protocols will be developed and implemented for all personnel utilizing the quarantine to insure proper use and maintenance of security. Inspections and training sessions will be periodically conducted. Records of imported and outgoing material will be kept for inspection. Organisms entering quarantine will be screened for pathogens, parasites and other contaminating organisms. All research and quarantine projects will be monitored to maximize utilization and proper use of the facility. Equipment and greenhouses will be kept operational and supplies made available to facilitate research and insect rearing.

Progress: 89/01 to 89/12. The purposes of the Insect Quarantine Laboratory are to 1) contain and isolate imported arthropods and nematodes for use in biological control of weeds and insects programs and for other studies; 2) to screen these organisms for parasites, pathogens and other contaminating organisms; and 3) to facilitate the introduction, release, augmentation, and study of organisms used for biological control. Researchers from Montana State University and USDA-ARS Rangeland Weeds Laboratory utilize this facility. In July, 1989, the glasshouses were reroofed with a new impact resistant plastic shell. Additional changes were made to the IQL including modifications to the waste water sanitizer and completion of the hydroponic room. Thirty-seven shipments, representing 21 species, were received at the IQL in 1989. Of these, 18 shipments (11 organisms) were released. Projects included the biological control of spotted and diffuse knapweeds, leafy spurge, musk thistle, dalmatian toadflax, St. Johnswort and Russian wheat aphid.

Publications: 89/01 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

63.001 CRIS0087181
GENETIC SPECIFICATION OF NEMATODE MUSCLE

ANDERSON R P; Genetics; University of Wisconsin, Madison, **WISCONSIN** 53706.
Proj. No.: WIS02712 Project Type: STATE
Agency ID: SAES Period: 01 FEB 82 to 31 JAN 88

Objectives: To describe more fully the isozymic forms of muscle myosin in C. elegans; to clone DNA sequences corresponding to myofilament protein structural genes; to identify additional genetic components of nmematode muscle; to analyze molecular details of mutant strains.

Approach: We shall use a combinatio of genetic, anatomical, and biochemical analyses to investigate the genetic complexity of nematode muscle. Genetic techniques involve the isolation, complementation, and mapping of mutations affecting muscle structure. Anatomical techniques involve electron miscroscopical analysis of mutatnt strains. Biochemical analysis techniques involve electron miscroscopical analysis of mutant strains. Biochemical analysis uses protein and recombinant DAN techniques to analyze molecular details of mutant strains.

Progress: 87/01 to 87/12. We have cloned and sequenced 11 insertions and 20 excisions of the transposable element Tc1 in the unc-54 myosin heavy chain gene. These results explain much of the genetic behavior of Tc1. We have cloned three new families of genetically active transposable elements in C. elegans. These elements will be valuable for study of transposon regulation in C. elegans. We have localized within the unc-54 myosin heavy chain gene the positions of mutations that disrupt the process of thick filament assembly. We have begun to sequence the mutations. We have completed the DNA sequence of the complete family of regulatory myosin light chain genes. This serves as necessary groundwork for our future investigations. We have characterized the mRNAs that are expressed from the regulatory myosin light chain genes. We discovered that one of the two myosin light chain genes is trans-spliced. We have identified muscle mutants of C. elegans that are due to myosin light chain defects. These are the first myosin light chain mutants known in any organism.

Publications: 87/01 to 87/12

COLLINS, J., SAARI, B. and ANDERSON, P. Activation of a transposable element in the germline but not the soma of C. elegans. Nature 328:726-728 (1987).

EIDE, D. and ANDERSON, P. Insertion and excision of the Caenorhabditis elegans transposable element Tc1. Mol. Cell Biol. 8:737-746 (1988).

BEJSOVEC, A. and ANDERSON, P. Myosin heavy chain mutations that disrupt C. elegans thick filament assembly. Cell (submitted).

CUMMINS, C. and ANDERSON, P. The regulatory myosin light chain genes of Caenorhabditis elegans. Mol. Cell. Biol. (submitted).

PULAK, R. and ANDERSON, P. The structures of spontaneous deletions in Caenorhabditis elegans. Mol. Cell. Biol. (submitted).

65.001 CRIS0034262
BIOLOGICAL COMPARISONS OF MORPHOLOGICAL VARIANTS COMPRISING XIPHINEMA AMERICANUM SENSU LATO

ROBBINS R T; ROBBINS R T; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK01199 Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 84 to 31 AUG 87

Objectives: PROJ 8400291. Determine species and distribution of X. americanum sensu lato occuring in U.S. Determine presence of TRSV, TmRSV in association with nematodes. Determine relationships between X. spp. by studying morphologically offspring of females within populations. Determine capabilities of species to vector viruses.

Approach: Populations of X. americanum s.l. will be established in the greenhouse. Nematodes will be killed, fixed and mounted. Morphologic comparisons will be made and analyzed. Populations will be screened for viruses using bait and indicator plants. Viruses recovered will be identified. Populations of X. americanum s.l. will be increased in growth chambers. Single nematodes of these populations will be tested for ability to acquire and transmit TRSV and TmRSV.

Progress: 87/01 to 87/12. Over 70 collections of Xiphinema were made from the southern half of the USA. The following species were tested by ELSIA for their ability to vector tobacco ringspot virus and tomato ringspot virus; Xiphinema americanum senso stricto, X. rivesi, X. bakeri, X. coxi and X. index. While both X. americanum and X. rivesi were found able to transmit both viruses there was much difference between populations in their ability to transmit them. Nine populations of X. americanum were found to differ from the normal range for at least one morphological character measurement. Minor differences in X. rivesi have also been noted. The fine structure of excised odontostyles and odontophores of Xiphinema spp., Longidorus spp. and Californidorus are being compared critically by scanning electron microscopy. Similarities and differeences will be presented in a paper in June at the Society of Nematology meetings. Males and all stages of X. coxi froma Gainesville, FL population are being described for the first time for publication.The pseudo-Z-organ of X. coxi is being studied and compared to other species publications by use of the transmission electron microscope. Most of the results of this project will be published as part of Mr. Cho's Ph.D. Thesis. He is due to finish in the summer of 1989.

Publications: 87/01 to 87/12
CHO, M.R. and ROBBINS, R.T. 1988. Morphological studies onstylets of Xiphinema, Longidorus and Californidorus by SEM. Journal of Nematology (Abstr.).

65.002* CRIS0143258
NPV, BACILLUS THURINGIENSIS, NEMATODES TO REDUCE POSTHARVEST INSECT LOSSES TO FRUITS & NUTS

VAIL P V; LINDEGREN J E; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-43000-018-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 88 to 30 SEP 91

Objectives: Develop selected strains of entomogenous nematodes with increased efficacy & application methods that optimize their control of postharvest/quarantineinsect pests. Develop micobial control (viruses & bacteria) agents againstinsect pests of postharvest dried fruit/nuts. Determine toxicity of plant produced Bt endotoxins to codling moth, Indianmeal moth and navel orange- worm. Determine resistance of Indianmeal moth to granulosis viruses.

Approach: Evaluate the selection potential of entogenous nematodes for improved infectivity & virulence to refractive hosts & increased survival under adverse storage or field conditions. Determine if nematode efficacy for control of navel orangeworm, codling moth, tephritid fruit flies & other posstharvest/quarantine insect pests can be enhanced by spray formulations,applicators & uniform droplet size. Test the efficacy for control of moth &beetle pests of postharvest dried fruits & nuts of a new baculovirus with a broad host range & new Bacillus thuringiensis strains. Bioassay two Bt endotoxins derived from plants against codling moth, Indianmeal moth & navel orangeworm. Determine toxicity & efficacy of walnut produced endo- toxins from embryos, seedlings, leaves and nuts. Evaluate engineered walnuts for field and postharvest protection. Five strains of IMM will be evaluated for susceptibility to granulosis viruses and then selected for resistance to the virus.

65.003* CRIS0049393
DETERMINE EFFICACY OF PATHOGENS FOR CONTROL OF QUARANTINE AND HORTICULTURAL INSECT PESTS

LINDEGREN J E; Ecology & Bio Control Res USDA Hort Crops Res Lab; Agricultural Research Service, Fresno, **CALIFORNIA** 93727.
Proj. No.: 5302-43000-006-00D
Project Type: INHOUSE
Agency ID: ARS Period: 30 SEP 84 to 30 SEP 89

Objectives: Develop standards for production storage life of entomogenous nematodes; develop spray methods for application of entomogenous nematodes; develop methods for utilizing entomogenous nematodes and other pathogens for the control of tephritid fruit flies, navel orangeworm and other problem insects.

Approach: Determine nematode concentration counts by weight, the o2 consumption of nematodes at different temperatures in storage and select a suitable pack- aging material that

will provide for maximum nematode shelf life; determineif the efficacy of entomogenous nematodes can be enhanced by additives, foam formulations and/or selected applications timing; evaluate laboratory and field applications of entomogenous nematodes and other pathogens as a soil drench or as an adult bait for the control of tephritid fruit flies.

Progress: 86/01 to 86/12. An effective in vivo rearing procedure has been developed that generates only the infective juvenile stage nematodes, does not require access to incubators, autoclave or toxic disinfectants, provides an aerobic high relative humidity environment, screens against unwanted contaminants, and produces approximately 150,000 infective juveniles nematodes per host wax moth larva. This method provides a readily available standardized and quality controlled source of freshly harvested nematodes for laboratory and small scale field investigations and is currently being successfully used by other research facilities. The survival and biological control potential of the entomogenous nematode Steinernema feltiae Filipjev was determined in newly split almonds under field conditions. Nematode suspensions (ca. 100 infective juveniles) were inoculated into newly split almonds. Nematode survival was assessed at the initiation of the test and at subsequent 24-hour intervals by the addition of two insectary-reared sixth instar navel orangeworm, Amyelois transitella (Walker), larvae per nut. The nematodes survived in the field and were invective to the larvae of the navel orangeworm for seven and eight days in Davis and Fresno orchards, respectively (temperature range 9C to 35C).

Publications: 86/01 to 86/12

LINDEGREN, J.E., RIJ, R.E., RDSS, S.R. and FDUSE, D.C. 1986. Respiration rate of Steinernema feltiae infective juveniles at several constant temperatures. J. Nematol. 18:221-224.

LINDEGREN, J.E. and VAIL, P.V. 1985. Susceptibility of Mediterranean fruit fly, melon fly and oriental fruit fly (Diptera: Tephritidae) to the entomogenous nematode, Steinernema feltiae in laboratory tests. Environ. Entomol. 5:465-468.

65.004 CRIS0034412
MASS PRODUCTION IN LIQUID CULTURE OF INSECT-KILLING NEMATODES

FRIEDMAN M; Biosystems Research Division; Biosis, Palo Alto, **CALIFORNIA** 94303.
Proj. No.: CALK-8802532 Project Type: SMALL BUSINESS GRANT
Agency ID: SBIR Period: 15 SEP 88 to 30 SEP 90

Objectives: The objectives relate to developing the large scale production of insect-killing nematodes. The objectives of Phase II are: Establish minimum requirements for mass transfer and maximal shear; investigate how reactor design parameters affect mass transfer and shear; and optimize process to support improvement of large scale operation.

Approach: An iterative process will be followed in which small scale experiments will be designed to respond to observed limitations in large scale operation.

65.005 CRIS0135435
AN EXPERT SYSTEM FOR THE AUTOMATIC IDENTIFICATION OF PLANT-PARASITIC NEMATODES

FERRIS H; FORTUNER R; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4931 Project Type: STATE
Agency ID: SAES Period: 28 JUL 88 to 30 SEP 92

Objectives: Redefine process of identification. Design and implement expert-system emulating process. Gather international cooperation of nematode taxonomists. Redescribe identification criteria and groups of species. Incorporate expert knowledge into expert-system.

Approach: A NATO Advanced Research Workshop on identification of plant-parasitic nematodes was held in Raleigh, NC in 1988. Workshop reviewed development of an expert-system for identification. Deliberations will be published as proceedings. Participants will develop lists of characters to be used in identification, groups of species that meet specific criteria, electronic data matrix of species and identification characters, knowledge base will be developed into expert-system. Subsequent meetings will deal with delivery and use of expert-system on worldwide basis.

65.006 0139861
EPIDEMIOLOGICAL APPROACH TO BIOLOGICAL CONTROL OF PLANT-PARASITIC NEMATODES

JAFFEE B A; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-5130-CG Project Type: CRGO
Agency ID: CRGO Period: 15 SEP 89 to 30 SEP 91

Objectives: PROJ. 8900989. To determine the threshold host (Heterodera schachtii) population density for maintenance of the parasite (Hirsutella rhossiliensis) in the nematode population. To determine if the proportion of nematodes parasitized is temporally dependent on nematode population density.

Approach: Nematode hosts will be added at different rates to soil microcosms containing a low level of the fungal parasite. The effect of rate of host addition on proportion of hosts parasitized will be determined. Critical parameters (e.g., spore production per host, spore longevity, and spore transmission) will be measured.

65.007 CRIS0034273
EPIZOOTIOLOGICAL POTENTIAL OF THE ENTOMOGENOUS NEMATODE, NEOAPLECTANA CARPOCAPSAE

KAYA H K; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4681-CG Project Type: CRGO Agency ID: CRGO Period: 15 SEP 84 to 30 SEP 87

Objectives: PROJ 8400285. To identify and quantify the interaction of physical soil factors on survival of Neoaplectana carpocapsae; and to determine the dispersal capability of N. carpocapsae in soil.

Approach: Persistence of the nematodes will be studied in different soil types at various temperatures. The nematode's persistence will be assessed over a period of time using bioassay methods. The dispersal capability of the nematode will be compared in soil with and without roots. The ability of nematode-infected adults to serve as a vehicle for dispersal will be studied in the greenhouse.

Progress: 84/10 to 87/09. The effect of soil moisture and temperature on survival of Steinernema feltiae and S. glaseri were conducted by nematode extraction and bioassay. Optimal survival was obtained at 2 and 4% moisture for S. feltiae and S. glaseri, respectively. Optimal temperature for survival was 25 C for S. feltiae and S. glaseri. S. feltiae survives better in cold temperatures (5 and 15) compared to high temperatures (35 C), while S. glaseri survives better at high temperatures compared to low temperatures. Adults of Spodoptera exigua are infected by S. feltiae as they emerge from soil and can survive up to 24 hours after infection. During the period from infection to death, these infected adults can fly and establish new foci of infection. Dispersal behavior of Heterorhabditis heliothidis in the presence or absence of roots in sandy soil showed that sparse roots (<0.5 g dried weight) had no effect on the nematode's ability to find an insect host compared to no roots. Dense roots (>1.5 g) affected the nematode's ability to find its host as the dense root treatments had a significantly lower mortality than no roots. Soil moisture may be less in the dense root treatments, resulting in restricted nematode dispersal.

Publications: 84/10 to 87/09
KAYA, H.K. 1987. Diseses caused by nematodes, pages 453-470. In: Epizootiology of Insect Diseases, J.R. Fuxa and Y. Tanada (eds.). John Wiley and Sons, New York.

65.008 CRIS0072313
UTILIZATION OF NEMATODES IN BIOLOGICAL CONTROL OF PESTIFEROUS INSECTS

KAYA H K; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-3492-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To obtain efficacy data on the effectiveness of steinernematid and heterorhabditid nematodes against soil insects; to determine the effects of chemical pesticides in the soil to these nematodes, to develop novel delivery systems for these nematodes, and to elucidate the biotic factors affecting nematode disperal and persistence.

Approach: Steinernema and Heterorhabditis effective against many soil-inhabiting insect pests, may be integrated in pest management systems by combining them with chemical and biological agents. Encapsulating nematodes in an alginate gel provide a mechanism for delivering them slowly into the soil which will protect them from antagonists. Biological antagonists will be identified to minimize their impact on the survival of these beneficial nematodes.

Progress: 87/01 to 87/12. The slow release of the entomogenous nematodes, Steinernema feltiae, and Heterorhabditis heliothidis from 1.0, 1.5, and 2.0% alginate capsules was studied. For S. feltiae the percentage of nematodes released ranged between 59 and 67% from the 1% capsules, between 40 and 78% from the 1.5% capsules and between 15 and 66% from the 2% capsules. The majority of nematodes emerged from the 1% capsules between the 2nd and 15th day, from the 1.5% capsules between the 13th and 22nd day, and from the 2.0 capsules between the 15th and 25th day. However, considerable variations were observed as once a given capsule had nematodes emerging, the nematodes within tended to emerge about the same time. For H. heliothidis, similar emergence patterns were observed, although the emergence times tended to be 5 to 7 days earlier from the 1.5 and 2.0% capsules compared to those with S. feltiae. H. heliothidis is being used to control black vine weevil larvae in containerized plantings at a professional building complex in San Francisco. The nematodes were applied at the rate of 132 infectives/cm , and alternate hosts were placed in one treatment and not in another. By using an insect bioassay, nematodes have been recovered from the alternate host treatment plots for over 5 months but in the plots with no alternate hosts, persistence of the nematode has been for no more than 6 weeks.

Publications: 87/01 to 87/12
SWAN, J.L. and KAYA, H.K. 1987. Entomogenous nematodes. In: Southern Cooperative Series Bulletin 318, C. W. McCoy, ed., pp. 19-22. Microbial agents for use in integrated pest-management systems. University of Arkansas Press.

KAYA, H.K., MANNION, C.M., BURLANDO, T.M. and NELSEN, C.E. 1987. Escape of Steinernema feltiae from alginate capsules containing tomato seeds. J. Nematol. 19:287-291.

CHOO, H.Y., KAYA, H.K., SHEA, P. and NOFFSINGER, E.M. 1987. Ecological study of nematode parasitism in Ips beetles from California and Idaho. J. Nematol. 19:495-502.

65.009 CRIS0014676
NEMATODE SYSTEMATICS AND MORPHOLOGY

MAGGENTI A R; NOFFSINGER E M; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-2045-H Project Type: HATCH Agency ID: CSRS Period: 01 JUL 87 to 30 SEP 91

Objectives: To expand and stabilize nematode taxonomy: Develop DNA/protein electrophoresis techniques for pathotype segregation and placement of higher taxa. Complete revision of Tylenchina. Identify plant-parasitic nematodes attacking California crops. Expand the UC nematode collection, concentrate on plant and animal parasites of California. Serve as resource for worldwide studies in nematology through scientific exchange and publications. To add to and maintain in the UC nematode collection, permanent mounts, mass collections and reference library.

Approach: DNA and protein electrophoresis, light microscopy, TEM, SEM and computer-aided techniques will be used. Resource collections and personnel net works will be maintained and expanded.

Progress: 87/01 to 87/12. The revision of the suborder Tylenchina jointly undertaken by A. R. Maggenti, D. J. Raski (UCD), M. Luc (France), R. Fortuner (CDFA), and E. Geraert (Belgium) is completed. As a result of this study, Tylenchina is now divided into 2 superfamilies, 9 families, 18 subfamilies and 116 genera. Rejected were: 2 suborders, 6 superfamilies, 29 families, 51 subfamilies and 134 taxa of the genus-group. Cosmocerca panamaensis a. Two new species of plant-parasitic nematodes of the genus Gracilacus were discovered: 1 on coastal redwood, and 1 from coastal spodozolic soil (pH 3.4). A study of Cosmocerca panamaensis a parasite of the panamanian poison-arrow frog was completed. In this study, the family-group authorship was established, as was the correct type species for the genus and the morphology of the reproductive system was clarified.

Publications: 87/01 to 87/12

FORTUNER, R. and MAGGENTI, A.R. 1987. A reappraisal of Tylenchina (Nemata). 4. The family Anguinidae Nicoll, 1935 (1926). Revue Nematol. 10:163-176.

FORTUNER, R. and RASKI, D.J. 1987. A review of Neotylenchoidea Thorne, 1941 (Nemata: Tylenchida). Revue Nematol. 10:257-267.

GERAERT, E. and RASKI, D.J. 1987. A reappraisal of Tylenchina (Nemata). 3. The family Tylenchidae Orley, 1880. Revue Nematol. 10:143-161.

HUANG, C.S. and RASKI, D.J. 1987. New records of Paratylenchus Micoletzky, 1922 from Brazil with descriptions of two new species (Tylenchulidae: Nemata). J. Nematol. 19:69-76.

HUANG, C.S., UESUGI, C.H. and RASKI, D.J. 1987. Xiphinema clavicaudatum sp. n. and X. fluminense sp. n. (Nemata: Longidoridae) from Brazil. Revue Nematol. 10:23-28.

LUC, M. and RASKI, D.J. 1987. On Macroposthonia and Criconemoides, again (Nemata: Criconematidae). Revue Nematol. 10:121-122.

LUC, M., MAGGENTI, A.R., FORTUNER, R., RASKI, D.J. and GERAERT, E. 1987. A reappraisal of Tylenchina (Nemata). 1. For a new approach to the Tylenchina. Revue Nematol. 10:127-134.

65.010 CRIS0066706
BEHAVIOR, PHYSIOLOGICAL & BIOCHEMICAL CHARACTERISTICS OF PLANT PARASITIC NEMATODES

VIGLIERCHIO D R; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-3119-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Assess molecular components and communication links of key structures, mechanisms and behavioral reactions of nematodes expressed during their life cycle. Establish in nematodes, mechanisms of function, communication, internally for development control and externally for perception, response and modification or adaption to micro environments.

Approach: By application of selected stress(nonfumigant nematicides, physiological inhibitors, growth hormones) on nematodes under controlled conditions followed by bioassay for evaluation of the response, (growth, development, reproduction). By interruption, blockage or modification of key processes (movement, reproduction, enzyme action) of normal conditions with synthetic or natural substances followed by analysis of altered enzymology or behavior.

Progress: 87/01 to 87/12. The behavioral response study of nematode adaptation to nonfumigant nematicide (NFN) stress has been extended to in vitro tests with Heterodera schachtii and Criconomella xenoplax. The pattern among all nematodes tested exhibits some similarity of change, but there exist specific differences reflected by an inherent characteristic of the nematode affected by a specific nonfumigant nematicide. It is impossible to predict the responses of a second nematode based upon observations of a first except in superficial terms. The NFN appear to be poor nematode acetylcholinesterase inhibitors, but do exhibit other biological properties that integrate into control activity. Elemental distribution in plants has been shown to be modified differently by root infection with different parasitic nematodes. Whereas, nematode facilitates translocation of nutrient elements others do not. There is a general tendency for nematode root infection to reduce the minor element nutritional component in plant tissue below that of uninfected plants. Nematode infection appears not to increase uptake by plants of heavy metals added to the plant nutrient supply.

Publications: 87/01 to 87/12

VIGLIERCHIO, D.R. 1988. Biological criteria in management considerations of Meloidogyne chitwoodi. Nematologica Mediterranea. In press.

YAMASHITA, T.T., VIGLIERCHIO, T.T. and KUO, F.F. 1988. The role of microbial populations from long-term nonfumigant nematicide treated soils on Heterodera schachtii nematode trials. Revue de Nematologie. In press.
VIGLIERCHIO, D.R. 1988. Elemental distribution in tissues of plants heavily infested with nematodes. In press.

65.011 CRIS0136124
MOLECULAR APPROACH TO A GENE CONFERRING NEMATODE RESISTANCE TO TOMATO

WILLIAMSON V M; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-5001-CG Project Type: CRGO Agency ID: CRGO Period: 01 JUL 88 to 30 JUN 91

Objectives: PROJ. 8800667. Mi is a dominant locus that confers resistance to root-knot nematodes when present in tomato. Our goal is to clone Mi to increase understanding of the mechanism of resistance conferred by this gene.

Approach: Mi is closely linked to Aps-1, encoding acid phosphatase-1 in tomato. Acid phosphatase-1 will be purified from cell suspension culture and used to produce antibody and obtain peptide sequence for identification of the corresponding cDNA. Using this clone and clones of other linked fragments (RFLPs) as probes, DNA from resistant and susceptible cultivars will be analyzed. Candidate clones of Mi will be obtained by "chromosome walking" techniques. We propose to identify Mi by complementation of function after transformation of susceptible tomato cultivars with candidate clones using Agrobacterium based vectors.

65.012 CRIS0014679
NEMATODE PATHOBIOLOGY AND BIOLOGICAL CONTROL OF PLANT-PARASITIC NEMATODES

MANKAU R; VAN GUNDY S D; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-1718-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Collect, catalog, & study organisms attacking nematodes; determine factors which influence activity, survival, & interaction with nematodes; develop techniques & practices which permit utilization of promising antagonists in agricultural production; examine effects of pesticides on natural enemies, nematode population dynamics, & the role of nematodes in the general microbial ecology of soil.

Approach: Isolated biocontrol agents will be studied by appropriate techniques, assayed for effectiveness & suitability in field application, & for persistence. Antagonists specific to major pests will receive most attention. The effects of pesticides, cultural practices, & amendments on biological control will be studied by monitoring nematode populations in fields where these practices are used & experimentally.

Progress: 87/01 to 87/12. Taxonomic studies of nematophagous fungi in the genera Arthrobotrys, Dactylella, Dactylaria and Monacrosporium are proceeding with a view toward revision of these genera and the preparation of monographs and keys of Arthrobotrys and Monacrosporium. More than 500 isolates have been collected, catalogued and studied. Pasteuria penetrans was cultured in vitro in M. javanica and M. incognita within A. rhizogenes transformed roots (TR) on modified M-S medium. Transformed tomato, potato and Convolvulus sepium all supported Meloidogyne populations and those infected with P. penetrans could be cycled through subcultures on TR and produced infective spores providing an excellent opportunity for sterile culture and study of the parasite. The abundant and highly varied flora of predacious fungi associated with citrus nematode-infested orchards have complex relationships with the citrus rhizosphere and rhizoplane and with the nematode population. On agar they exhibit a variety of growth responses and behavior which are influenced by specific C/N ratios, pH and other factors. Most of these fungi trap and consume citrus nematode larvae very effectively in vitro but in nature they may play an incidental cumulative antagonist role which results in the equilibration of the nematode population by subtle uncontrollable interactions. Over 5,000 bacterial isolates were screened for antagonism to root knot nematodes, fusarium wilt, and for plant growth enhancement.

Publications: 87/01 to 87/12
GASPARD, J.T. and MANKAU, R. 1987. Density-dependence and host-specificity of the nematode-trapping fungus Monacrosporium ellipsosporium. Revue Nematol. 10:241-246.
GASPARD, J.T. and MANKAU, R. 1987. Nematophagous fungi associated with Tylenchulus semipenetrans and the citrus rhizosphere. Nematologica 33:359-364.
MANKAU, R. and BARTNICKI, E.W. 1987. Studies on the biology of nematode-trapping fungi associated with the citrus nematode, Tylenchulus semipenetrans. J. Nematol. 19:540.
VERDEJO, S., JAFFEE, B.A. and MANKAU, R. 1987. The use of Agrobacterium rhizogenes transformed root cultures for the reproduction of Meloidogyne javanica and Pasteuria penetrans. J. Nematol. 19:560.

65.013 CRIS0062894
NUTRITION OF NEMATODES

PLATZER E G; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-2866-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: To study the nutritional requirements of nematodes by: 1) developing methods and media for the axenic cultivation of

insect parasitic nematodes; 2) characterize developmental changes in insect-parasitic nematodes to facilitate studies on nutritional requirements; and 3) analyze the biochemical environment of insect parasitic nematodes.

Approach: Developmental changes in Romanomermis culicivorax, a parasite of mosquito larvae, will be characterized by transmission electron microscopic studies of the glycocalyx and cuticle during the life cycle. Polyacrylamide gel electrophoresis, lectin- and antibody-binding studies will also be performed to determine developmental changes that are important in nutritional interactions with the host. This information will be used to modify the current static culture system and culture medium into a dynamic system incorporating media changes in synchrony with developmental changes in the host.

Progress: 87/01 to 87/12. The biochemical changes in Romanomermis culicivorax cultured in vivo were measured. Total protein was the most sensitive indicator of growth based on comparisons with length and dry weight measurement. In addition, the amino acid composition of R. culicivorax was determined for major developmental stages. This information served as a basis for evaluation of nematode growth and development in R. culicivorax cultured in vitro. A culture medium based on Grace's Insect Tissue Culture medium with salt concentrations altered to those for Culex pipiens hemolymph was optimal for R. culicivorax. However, full development didn't occur and further refinements of culture conditions are mandatory.

Publications: 87/01 to 87/12

GIBLIN, R.M. and PLATZER, E.G. 1987. In vivo growth of Romanomermis culicivorax: biochemical changes during parasitism. J. Nematol. 19:123-129.

GIBLIN, R.M. and PLATZER, E.G. 1987. Evaluation of culture media for axenic growth of Romanomermis culicivorax. Revue Nematol. 10:67-74.

65.014 CRIS0095741
ENTOMOPATHOGENS FOR USE IN PEST MANAGEMENT SYSTEMS

PLATZER E G; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4539-RRProject Type: HATCH Agency ID: CSRS Period: 13 JUN 85 to 30 SEP 89

Objectives: To identify, characterize and standardize entomopathogens and entomopathogenic formulations to be used in regional trials of efficacy.

Approach: A substantial program on compositional analysis of host hemolymph has been completed and this information will be used in the formulation and development of an in vitro culture system for Romanomermis culicivorax, a mermithid nematode parasitic in mosquito larvae. Such a development will improve and optimize the potential of mass rearing of mermithid nematodes for biological control. Studies on physiology of hatching will be conducted to control storage and release of the nematode for biological control. In addition, studies on low temperature storage of infectious stages will be conducted to improve storage of mermithids for inundative control of mosquitoes.

Progress: 87/01 to 87/12. The P NMR spectrum of the dauer larvae of Steinernema feltiae was composed of seven major peaks. Energy storage compounds such as creatine phosphate or arginine phosphate were not observed. The findings were similar to those reported by others for Ascaris. Under the static in vitro conditions used, the ATP concentration didn't decline significantly for 5 h, however, an upfield shift of the inorganic phosphate peak indicated cytoplasmic acidification in the nematodes. Sugar phosphates declined precipitously during the first h and remained stable thereafter. P NMR spectroscopy has provided a rapid and non-invasive method for measurement of phosphorus metabolites and related energy metabolism in nematodes.

Publications: 87/01 to 87/12

PLATZER, E.G., THOMPSON, S.N. and LEE, R.W.K. 1987. In vivo _3_1P NMR spectrum of Steinernema feltiae. J. Nematol. 19:551 (Abstr.).

65.015 CRIS0096636
MOLECULAR DIAGNOSTICS OF PLANT PARASITIC NEMATODES

PLATZER E G; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4575-CG Project Type: CRGO Agency ID: CRGO Period: 01 SEP 85 to 31 AUG 89

Objectives: Proj. 8500495. To develop recombinant DNA techniques for detection of host-races of root-knot nematodes (Meloidogyne spp.). Such studies will facilitate selection of appropriate resistant cultivars, crop rotation, or biological contron in crop management strategies.

Approach: Mitochondrial DNA will be isolated from populations of root-knot nematode species and host-races. The mt DNA will be characterized physically by fine structure restriction mapping. Libraries of recombinant DNA hybrid plasmid molecules containing mt DNA from host-races will be constructed, screened for use in diagnostic molecular probes and assessed for sensitivity to nematode lysates from soil extracts.

Progress: 87/01 to 87/12. Meloidogyne chitwoodi, the Columbia root-know nematode, results in severe wheat and potato crop losses in the Pacific Northwest. Because of similarities in general morphology and pathogenic symptoms, diagnosis of M. chitwoodi infections is difficult to distinguish from M. hapla and M. incognita. As we have previously demonstrated the diagnostic utility of mitochondrial DNA (mtDNA) for nematode identification, we have begun to physically

characterize the M. chitwoodi mitochondrial genome. Restriction enzyme analysis has revealed that this mtDNA is 20 kb and shares many DNA fragments in common with M. incognita, M. arenaria, and M. javanica. However, restriction products are distinctly different between M. chitwoodi and M. hapla, and useful diagnostic bands have been identified between M. chitwoodi and M. incognita. Molecular cloning and sequence analysis of these individual DNA fragments will confirm the diagnostic potential of these diverging mtDNA loci in a rapid soil DNA hybridization assay that we have developed.

Publications: 87/01 to 87/12

HYMAN, B.C., PELOQUIN, J.J. and PLATZER, E.G. 1987. Physical constitution of the Meloidogyne chitwoodi mitochondrial genome. J. Nematol. 19:528 (Abstr.).

65.016* CRIS0141452
BIOREGULATION OF INSECT-PLANT INTERACTIONS

MAYER R T; SCHROEDER W J; SHAPIRO J P; Agricultural Research Service, Orlando, **FLORIDA** 32804.
Proj. No.: 6617-24000-004-00D
Project Type: INHOUSE
Agency ID: ARS Period: 28 MAY 86 to 27 MAY 91

Objectives: Determine effect of plant products on insect reproduction, feeding, digestion, hormones, and chitin metabolism. Characterize vector relationships and phytoalexins in resistant plants. Identify and characterize biological control agents for insect pests, and develop control systems for their application.

Approach: Involves use of diverse techniques including methods in histology, electrophoresis, spectroscopy, fluorimetry and bioassay and immunoassay (ELISA, RIA, SSEM, fluorescent antibody), microscopy (TEM, SEM, LM), probes(dsRNA, antibody, fluorescent, and cDNA), centrifugation, chromatography (affinity, TLC, gel, HPLC), microscopy, isotopes, hemagglutination, and hybridomas.

Progress: 87/01 to 87/12. A bioassay was developed using Mexican lime leaves on an agar media in petri dishes that allows assessment of virulence of Verticillium sp. against citrus aphids; the assay is facile and provides a more rapid method for determination of fungal biocontrol agents to control citrus aphids. Use of a nematode (Steinernema feltiae) isolated from infected larvae of Diaprepes abbreviatus coupled with a new method to increase the efficacy of the entomogenous nematode was shown to reduce citrus root weevil populations to economic threshold levels not previously attainable. These methods will be of interest to all biocontrol programs that utilize nematodes as the biocontrol agents and to the citrus industries in Florida and the Caribbean Basin. Spectrofluorometric studies showed that natural and synthetic xenobiotics (coumarins) are absorbed by hemolymph proteins after ingestion. A model system was subsequently developed to observe binding to hemolymph proteins in vivo and in vitro and to determine if it is possible to alter the dynamics of binding and absorption such that a control method can be developed. An in vitro, cell-free assay for chitin synthase has been developed utilizing gut tissue from D. abbreviatus larvae; this method will allow for testing of chitin synthesis inhibitors against the citrus root weevil and for investigations on the chitin metabolic pathway in this insect.

Publications: 87/01 to 87/12

SCHROEDER, W.J. 1987. Laboratory bioassays and field trials of entomogenous nematodes for control of Diaprepes abbreviatus (Coleoptera: curculionidae) in citrus. Environ. Entomol. 16:987-989.
SCHROEDER, W.J. and BEAVERS, J.B. 1987. Movement of the entomogenous nematodes of the families heterorhabditidae and steinernematidae in soil. J. Nematol. 19(2):257-259.
SCHROEDER, W.J. 1987. Induced pupation in Diaprepes abbreviatus (Coleoptera: curculionidae). Fla. Entomol. 70(1):186-187.
SHAPIRO, J.P. 1988. Isolation and fluorescence studies on a lipophorin from the weevil Diaprepes abbreviatus. Arch. Insect Biochem. Physiol. (Accepted December 1987).
CHEN, A.C., KIM, H.R., MAYER, R.T. and NORMAN, J.O. 1987. Vitellogenesis in the stable fly, Stomoxys calcitrans. Comp. Biochem. Physiol., 88B(3):897-903.
MAYER, R.T. et al. Evidence that chitin synthesis inhibitors affect cell membrane transport. Proc. Intern. Conf. on Endocrinological Frontiers in Physiological Insect Ecology. (Accepted September 1987).
SHAPIRO, J.P., LAW, J.H. and WELLS, M.A. 1988. Lipid transport in insects. Annu. Rev. Entomol. 33:297-318.

65.017 CRIS0131247
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

DICKSON D W; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02624 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation and to develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: The population dynamics of Meloidogyne arenaria will be studied under a bahiagrass and peanut rotation scheme. The effect of different populations of M. arenaria race 1 and 2 will be determined on soybean germplasm.

Progress: 87/10 to 88/09. A bioassay for the number of spores of a known Pasteuria penetrans population in soil was developed. The bioassay entails incubating spore-free juveniles of a known host nematode in P. penetrans infested

soil for 3 days. The number of nematodes with spores attached was counted. The sensitivity of the bioassay increased with an increase in nematode inoculum up to 100 juveniles/ml soil. The attachment of spores to the nematodes was not altered over a wide range (25-75% of field capacity) of soil moistures. The host specificity of different populations of P. penetrans was tested in an in-vitro bioassay. Pasteuria penetrans populations obtained from different phytoparasitic nematodes showed marked differences in their host affinity. The effects of rotations of peanut-fallow, peanut-rye, or peanut-vetch on the dynamics of Pasteuria penetrans on Meloidogyne arenaria race 1 in field microplots were studied. There were no differences in root penetration or yield in the initial peanut crop between healthy and P. penetrans-infested nematodes; but penetration of pods by the nematode was reduced by the antagonist (P=0.05). At harvest the average infestation of second-stage juveniles was 0.11 spores per nematode. In the spring the levels were 0.23, 0.16, and 0.11 following rye, vetch, or fallow, respectively. There were no significant differences (P.=0.05), however, among the treatments.

Publications: 87/10 to 88/09

HEWLETT, T.E., DICKSON, D.W., MITCHELL, D.J. and KANNEVISCHER-MITCHELL, M.E. 1988. Evaluation of Paecilomyces lilacinus as a biocontrol agent of Meloidogyne javanica on tobacco. J. Nematol. 20:578-584.

DAVIS, E.L., KAPLAN, D.T., PERMAR, T.A., DICKSON, D.W. and MITCHELL, D.J. 1988. Characterization of carbohydrates on the surface of second-stage juveniles of Meloidogyne spp. J. Nematol. 20:609-619.

65.018 CRIS0099424

BIOLOGICAL INVESTIGATIONS OF NEMATODE STRESS ON CORN YIELDS

DICKSON D W; MCSORLEY R T; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02573 Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 86 to 31 AUG 88

Objectives: PROJ 8600393. The long term goal is to determine the influence of a polyspecific community of plant-parasitic nematodes on plant stress and on the expression of that stress in measurable yield components of corn in the USA. Specific objectives are: 1) to quantify the effects on the host of the major nema genera singly and in various combinations found in polyspecific nema communities; 2) to determine whether temperature and vertical distribution can influence the population dynamics of individual species sufficiently to cause a separation of the species within the polyspecific community in time and space.

Approach: Microplots of single and polyspecific communities of nemas will be analyzed in a 2x2x2 factorial design with 6 replicates. Main effects will be the 3 nemas, Belonolaimus longicaudatus, Pratylenchus brachyurus and Meloidogyne incognita. For each species 2 levels will be used, absence and presence of damaging levels. In the field, nematode relationships between yields and nematode densities at various times and depths will be developed by multiple regression analysis. Periodic sampling will permit the construction of nema population curves over time and these will be correlated with temperature fluctuations and heat units accumulated from the field.

Progress: 86/09 to 88/08. Two major objectives were accomplished by this project: Quantification of nematode effects on the host: In 1987 field plots, significant (P<0.05) negative correlations were observed between corn yield (kg/ha), and Belonalaimus longicaudtus populations measured prior to planting as well as during the season. Similar negative correlations were also observed between B. longicaudatus density and plant stand or dry top weight at harvest. Significant negative correlatioons between yield and densities of other species were few, and no significant multiple regression equations could be derived involving species other than B. longicaudatus. In 1988, only dry top weight showed negative correlations with B. longicaudatus densities. For all significant relationships, regression equations were developed relating yield to the log(2) of B. longicaudatus density. Determination of population dynamics of the nematode community: In the field plots, no significant (P</-0.05) correlations were obtained between the population density of one nematode with that of any other species. Similarly, in two trials in which B. longicaudatus, Pratylenchus brachyurus, and Meloidogyne incognita were inoculated alone and in combination into microplots, population growth was usually unaffected by the presence of other species. An exception occurred in the 1988 microplot test, when M. incognita juveniles extracted from roots were significantly (P</-0.01) reduced in microplots with P. brachyrus.

Publications: 86/09 to 88/08

NO PUBLICATIONS REPORTED THIS PERIOD.

65.019 0138971

BIOCONTROL OF PLANT PARASITIC NEMATODES WITH PASTEURIA SPP. AND OTHER SOILBORNE ANTAGONISTS

DICKSON D W; MITCHELL D J; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-ENY-02828
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 89 to 30 JUN 90

Objectives: Our goals are to evaluate the diversity of Pasteuria spp. in regard to their host-range and pathogenicity, their ecological requirements, and their potential use in practical nematode management schemes. Specific objectives are to establish a collection of isolates of Pasteuria spp. antagonistic to the major nematode pest of tropical and subtropical soils; to determine the variability in host range and in pathogenicity to nematodes; to elucidate ecological requirements of Pasteuria spp.; to evaluate the efficacy of several

populations of Pasteuria spp. under field conditions; to follow the natural population dynamics of Pasteuria spp. and their host nematode under different rotation schemes.

Approach: Populations of Pasteuria spp. and other antagonists of nematodes will be collected from soils suppressive to plant-parasitic nematodes. Each collection will be screened to determine their host ranges. Penetration and infectivity of nematodes will be the criteria used to define a pathogenic relationship. Some antagonist's response to basic environmental factors will be studied. Efficacy experiments are planned with defined inoculum levels of selected populations of Pasteuria sp. in field microplots. A 3 year study will be initiated in a soil that was recently identified as suppressive to Meloidogyne are naria. The field will be monitored for nematode dynamics and for the impact of cropping sequences on root galling and peanut yield.

Progress: 88/10 to 89/09. The effects of spring-fall rotations of peanut with fallow, vetch, and rye on the dynamics of Pasteuria sp. on Meloidogyne arenaria were studied. Treatments included second-stage juveniles (J2) of M. arenaria, J2 infected with Pasteuria sp., and an untreated control. Each treatment was replicated 10 times for each rotation. The infection level of Pasteuria sp. on the J2 changed from 0.11 spores/nematode in the fall to 0.11, 0.23, and 0.16 spores/nematode in the spring under fallow, rye, and vetch, respectively. In the following fall, the respective infection levels of Pasteuria sp. were 0.33, 0.61, and 0.75 spores/nematode. At harvest nematode infection of peanut pods was reduced (P = 0.05) in plots infested with Pasteuria sp. when compared to plots with healthy nematodes. A reduction (P = 0.05) of nematode infection of roots was observed 38 days after planting in 1988 in all three rotations. There were no differences (P = 0.05) in yield and nematode population levels at harvest in either year between treatments with healthy nematodes and nematodes infected with Pasteuria sp.

Publications: 88/10 to 89/09
NO PUBLICATIONS REPORTED THIS PERIOD.

65.020 CRIS0082837
TAXONOMY AND MORPHOLOGY OF NEMATODES

SMART G C JR; TARJAN A C; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02024 Project Type: STATE
Agency ID: SAES Period: 21 SEP 80 to 30 DEC 87

Objectives: Collect and identify any plant, soil and aquatic nematodes that are of significance to the agricultural economy of Florida. Study and describe the anatomy and morphology of such nematodes in order to facilitate identification by concerned research workers and regulatory personnel. Determine the existence of biotypes and economically important nematode species which may influence current Integrated Pest Management and Low Energy Technology practices being employed. Prepare taxonomic treatises, systematic keys, compendia and morphological descriptions for publication in national and international scientific journals.

Approach: Acquire, preserve, mount on slides and study morphologically. New taxons will be described and published. Accumulated data may lead to taxonomic revisions and compendia preparation.

Progress: 87/01 to 87/12. A neoaplectanid nematode being used for biological control of mole crickets has been determined to be a new species. A description is being prepared. The previous report on this project told of a computerized, illustrated key for nematode identification. This key has been completed and is being evaluated by interested personnel in the United States and three foreign countries. Although the existing key is for identification of marine nematodes by students and novice taxonomists, the program also contains files which will allow the user to prepare a computerized key on almost any subject. The marine nematode identification program, called "Marinema" occupies 17 Kb of random access memory, while the related data files use about 600 Kb of storage. Five utility programs using 84 Kb of storage aid in manipulating or correcting data files. The program uses the MS-DOS operating system and must be used with a color monitor. Work continues on preparation of a revision of the genus pratylenchus. All available references have been inspected for any diagnostic information that may be used in separating species. It is planned to incorporate the finished key into the University of California computerized nematode identification scheme, which at present includes only the genus helicotylenchus.

Publications: 87/01 to 87/12
TARJAN, A.C. and VINTON, R.L. 1986. A novice-oriented computer program for identification of the more common marine nematodes. (Abstr.) Jour. Nematology 18 (4): 632.

65.021 CRIS0132210
TAXONOMY AND SYSTEMATICS OF NEMATODES

TARJAN A C; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02630 Project Type: STATE
Agency ID: SAES Period: 13 JUL 87 to 30 SEP 92

Objectives: To collect and identify any plant, soil and aquatic nematodes of significance to the economy of Florida. To study and describe the anatomy and morphology of such nematodes. To intensively study selected taxonomic units (genera & subfamilies) and subsequently to prepare taxonomic treatises, systematic keys and compendia for publication.

Approach: Acquire specimens by collection or culture. Kill, fix and mount specimens for microscopic study. Make measurements, drawings

and photos of important species. To maintain a teaching collection, a marine nematode collection and a collection of Florida nematodes. Storage of essential data on species will be computerized.

Progress: 87/10 to 88/09. Analysis of descriptions of 89 species of Pratylenchus revealed that a number of species were erected on weak, inadequate comparisons, subjective criteria, a minimal number of specimens, and/or insufficient diagnostic data. Dnly a few investigators have reported studies on the extent of variation in certain species. Nine nominal species are regarded synonyms of older species. The results of this study reveal that the genus currently is composed of 49 valid species. A pictorial key to 118 genera of free-living marine nematodes in the order Enoplida has been prepared. Specific morphological and anatomical features were illustrated to facilitate use of the key. The purpose of the work is to provide a single key to the genera of enoplid nematodes to facilitate identification of these organisms by nematologists and marine biologists working with the meiofauna. Diagnostic characters of genera included in the Axonolaimidae (Filipjev, 1918) were determined by scrutiny of original and subsequent descriptions and figures, and by studying specimens of Apodontium Cobb, 1920 and Margonema Cobb, 1920. The study of Apodontium showed the genus to have a unique stoma; and not to be congeneric with Synodontoides as previously proposed. The validity of Parascolaimus Weiser, 1959 is questioned but the genus is retained pending future studies. Family affiliation includes a variety of amphidial shapes (excluding circular), shape of the stoma, number of the post-labial setae, and body size.

Publications: 87/10 to 88/09

TARJAN, A.C. and FREDERICK, J.J. 1988. Proposed synonymies within the genus Pratylenchus Filipjev, 1936 (abstr.) Nematropica 18(1):21-22.

YIN, K., FANG, Y. and TARJAN, A.C. 1988. A key to species in the genus Bursaphelenchus with a description of Bursaphelenchus hunanensis sp. (Nematoda=Aphelenchoididae) found in pine wood in Hunan Province, China. Proc. Helm. Soc.

TARJAN, A.C. and KHUDNG, N.B. 1988. A compendium of the family Axonoloaimidae, (Nematoda). Cahiers Biologie Marine XX:19 pp. in press.

FREDERICK, J.J. and TARJAN, A.C. 1989. A compendium of the genus Pratylenchus Filipjev, 1936 (Nemata: Pratylenchidae). Revue de Nematologie, ca 18-19 pp, in press.

65.022 0144052

NEMATODE MANAGEMENT PRACTICES FOR THE SOUTHEAST TO REDUCE GROUNDWATER CONTAMINATION

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Proj. No.: 6602-13240-001-00D

Project Type: INHDUSE

Agency ID: ARS Period: 20 JAN 89 to 01 JAN 94

Objectives: Develop technology to manage root-knot, sting, and other nematodes with reduced chemical application rates and increased efficacy. Determine relationships between nematicide concentrations and nematode population densities, and relationships between nematode population density and damage to root function. Develop a model for nematicide behavior and fate in soil and groundwater.

Approach: Nematode management technology, using laboratory, greenhouse, and field experiments (standard and new techniques) including formulation innovations for nematicides, crop rotations, cultural practices, resistant varieties, cover crops, tillage methods, and nemagation will be developed. Nematode population densities, root-gall indices, crop response, yield and quality will be recorded. A model for nematicide behavior and fate in soils and groundwater will be developed. The model development will be used to define environmental process parameters and chemical properties that control nematicide behavior and efficacy. The research will be conducted in cooperation with agricultural engineers, agronomists, horticulturists, economists, entomologists, plant pathologists, modelers, weed scientists, and soil/water scientists at Tifton, GA; Ft. Collins, CO; Beltsville, MD; Peoria, IL; New Drleans, LA; and other locations.

Progress: 89/01 to 89/12. This is a new project. Groundwater sampling equipment has been designed and installed in field plots to determine the concentrations of nematicides (fenamiphos and others) in surface and groundwater as affected by tillage practices and conventional vs. chemigation pesticide application. A leaching experiment to determine the effects of controlled-release formulations of herbicides and an experimental tank-adjuvant leach-inhibitor on mobility were determined in packed soil columns using both bioassay and residue analysis has been completed. A similar experiment with nematicides using smaller "undisturbed" cores from three different Coastal Plain soil types is in progress. A Research Associate, Dr. Benali Burgoa, soil physicist from the University of Florida, has been recruited and will come on board February 1990. A scenario (data set) for the ARS "RZWQM" water-quality model giving complete weather, soil, crop growth, and pesticide application data is being constructed in cooperation with the UGA Extension Service for cotton grown on a well-characterized watershed at Tifton. This data set will be the first tested on the RZWQM model. Manuscripts reporting on deposition of chlorpyrifos under chemigation, thr persistence of alachlor in the vadose zone, and a review of pesticide solubilities have been submitted for publication.

Publications: 89/01 to 89/12

WAUCHDPE, R.D. 1989. Ag chemicals Environmental fate. Farm Chemicals 152 28.

WAUCHDPE, R.D., WILLIAMS, R.G. and MARTI, L.R. 1989. Runoff of sulfometuron-methyl and cyanazine from small plots. Effects of formulation... J. Environ. Qual. 19. Accepted August 9, 1989.

WAUCHOPE, R.O., WILLIAMS, R.G. and L.R. MARTI. 1989. Runoff of sulfometuron-methyl and cyanazine from small plots under simulated rainfall... Abstr. Weed Sci. Soc. Amer. p. 99.
POTHULURI, J.V., MOORMAN, T.B., OBENHUBER, O. and WAUCHOPE, R.O. 1989. Persistence of alachlor in surface soils and groundwater aquifers under anaerobic conditions. Abstr. Weed Sci. Soc. Amer. p. 217.

65.023 CRIS0095605
MANAGEMENT OF HETERODERA GLYCINES AND MELOIDOGYNE INCOGNITA ON SOYBEAN

HUSSEY R S; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000865 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Management of Heterodera glycines and Meloidogyne incognita on soybean. Identify the biologically active molecules secreted by M. incognita that elicit the susceptible response in plants.

Approach: Damage thresholds of root-knot and cyst nematodes resistant compared to susceptible cultivars will be determined in microplots. Soybean germplasm will be evaluated for SCN tolerance. Breeding lines with resistance to SCN races 3 and 4 in their parentage will be screened in heavily infested fields. Interactions between SCN and M. incognita (MI) will be investigated. Immunogen preparation: Secretions or secretory granules will be collected and evaluated using three different methods. Antibody Production: Because of limited quantity of immunogen two approaches to antibody production will be used; 1) immunize mouse cells in vitro by procedure of Van Ness et al, and 2) the more conventional in vivo immunization, but to immunize mice in optimal fashion.

Progress: 87/01 to 87/12. Interactions among Meloidogyne incognita (Mi), Pratylenchus brachyurus, (Pb), and soybean genotype on plant growth and nematode reproduction were studied in a greenhouse. Coker 317 (susceptible to both nematodes) and Gordon (resistant to Mi, susceptible to Pb) were inoculated with increasing initial population densities (Pi) of both nematodes individually and combined. Mi and Pb individually usually suppressed shoot growth of both cultivars, but only root growth on Coker 317 was influenced by a MixPb interaction. Reproduction of both nematodes, although dependent on Pi, was mutually suppressed on Coker 317. Pb reproduced better on Gordon than on Coker 317 but did not affect its resistance to Mi. Root systems of Coker 317 were split and inoculated singly or combined with Mi and Pb to determine the nature of the interaction. Mi suppressed reproduction of Pb either when co-inhabiting a half-root system or infecting opposing half-root systems; however, Pb affected Mi only if both nematodes infected the same half-root system. The effect of concomitant infection on penetration of soybean roots by either species was studied. More second-stage juveniles of Mi penetrated roots of Coker 317 than roots of Gordon soybean whereas Pb more readily penetrated roots of Gordon than Coker 317. Neither nematode species affected root penetration by the other species on dually inoculated plants harvested at 4, 8, or 12 days after inoculation.

Publications: 87/01 to 87/12
HUSSEY, R.S. 1987. Secretions of esophageal glands of Tylenchida nematodes, Pages 221-228. In Vistas on Nematology, J.A. Veech and O.W. Dickson, eds. Hyattsville: Society of Nematologists.
HUSSEY, R.S. and MCGUIRE, J.M. Interaction with other organisms. Pages 293-328. In Principles and practices of nematode control in crops. R.H. Brown and B.R. Kerry, eds. Orlando: Academic Press.
BOERMA, H.R., HUSSEY, R.S. and REESE, P.F., JR. 1986. Tolerance to soybean cyst nematode. Pages 76-83 In Proceedings of the 16th Soybean Seed Research Conference. Washington: American Seed Trade Association.
HERMAN, N. 1986. Interaction between Meloidogyne incognita and Pratylenchus brachyurus on soybean. M.S. Thesis. University of Georgia.
REESE, P.F., JR., BOERMA, H.R. and HUSSEY, R.S. 1987. Heritability of tolerance to Heterodera glycines in soybean. Agronomy Abstracts. Page 77.
WALLER, R.S., BOERMA, H.R. and HUSSEY, R.S. 1987. Natural selection for soybean cyst nematode resistance. Agronomy Abstracts. Page 83.

65.024 CRIS0131228
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

HUSSEY R S; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000923 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation. To develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: The interaction of soybean germplasm resistance and nematode virulence will be determined in a uniform regional test. All cultivars, advanced breeding lines, and other suitable material will be distributed to all project leaders. Each cultivar will be tested with several different isolates of H. glycines and major species and race of meloidogyne for reproduction and compared to a standard susceptible host. Nematode races and species will be monitored by standard differential host tests for regional shifts in race and species composition. Experiments will be conducted to find biotic and abiotic factors that influence population densities of root-knot and cyst nematodes. Selected soybean lines tolerant of nematode development will be evaluated regionally against several nematode isolates, in cooperation with plant breeders. The effects

of root morphology and growth pattern on nematode invasion and development will be evaluated.

Progress: 87/01 to 87/12. Soybean genotypes (2,370) in the Southern Germplasm Collection (MG V, VI, VII, and VIII) were sequentially screened in a greenhouse to identify the highest levels of resistance to M. incognita (Mi), M. arenaria (Ma) and M. javanica (Mj) based on root galling and nematode reproduction. After three levels of screening using an inoculum density of 2,000 nematode eggs per plant, 61, 56, and 61 genotypes were identified as resistant to Mi, Ma, and Mj, respectively. In the next two screening levels, three inoculum densities were used to differentiate the levels of resistance among these genotypes. The screening for Mi identified 'Amredo', PI96354, PI408088, and PI417444 with lower gall indices, fewer eggs per root system, and eggs per gram of root than 'Forrest', the resistant check. In the Ma screening PI200538 and PI230977 had lower gall indices and fewer eggs per root system than 'Jackson', the resistant check. The Mj screening identified PI230977 with a lower gall index than 'Gordon', the resistant check. Two of the genotypes (PI 96354, PI 417444) highly resistant to Mi were grown in field microplots with increasing initial population densities (Pi) of Mi. Boosier and Forrest were the susceptible and resistant checks, respectively. Pi were 0, 31, 125, and 500 eggs/100 cm . Fewer second-stage juveniles (J2) penetrated PI 96354 at 14 days after inoculation than the other genotypes. Mi J2 population densities were directly related to Pi at 60 and 90 days for all genotypes.

Publications: 87/01 to 87/12

LUZZI, B.M., BOERMA, H.R. and HUSSEY, R.S. 1987. Resistance to three species of root-knot nematode in soybean. Crop Science 27:258-262.

HUSSEY, R.S. and BOERMA, H.R. 1987. Greenhouse ratings for resistance to soybean cyst nematode and three species of root-knot nematode. Pages 30-31. In 1986 field crops performance tests.

65.025 CRIS0136628
CHARACTERIZATION OF DISEASE-INDUCING SECRETIONS PRODUCED BY ROOT-KNOT NEMATODES

HUSSEY R S; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GEO-RC299-144 Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 88 to 31 AUG 90

Objectives: PROJ. 8800272. Generate monoclonal antibodies to disease inducing secretions of second-stage juveniles of Meloidogyne incognita, identify by immunocytochemistry secretory components injected into plant cells, purify and characterize the secretory components.

Approach: Balb/C mice will be immunized with immunogens from second-stage juveniles or adult females of M. incognita. Hybridomas will be screened by an indirect immunofluorescence procedure with sections of nematodes. Cell lines identified as producing antibodies specific to secretory granules formed in the esophageal glands will be cloned and purified. A panel of antibodies to different secretory components will be selected by immunoblotting. The antibodies will be used in ultrastructural immunocytochemistry experiments to localize the antigen in the granules in the nematode and in the giant cells induced in the plant by the nematode. Antigens identified as being secreted through the stylet will be immunoaffinity purified and characterized biochemically.

65.026 0139236
2-D PROTEINS AND DNA COMPARISONS IN SOYBEAN CYST AND RELATED NEMATODES

FERRIS V R; Entomology; Purdue Res Foundation, West Lafayette, **INDIANA** 47907.
Proj. No.: IND058020G Project Type: CRGO
Agency ID: CRGO Period: 15 SEP 89 to 30 SEP 91

Objectives: PROJ. 8900913. To obtain DNA data for comparison with data from two-dimensional (2-D) protein patterns of geographically separated isolates of important cyst nematodes in order to better understand relationships among nominal races, strains and pathotypes of these pests of crop plants.

Approach: Generate DNA data for restriction fragment length polymorphisms (RFLPs) among isolates using probes for known gene sequences and random probes from genomic libraries; construct maps of restriction sites; clone and sequence restriction fragments and evaluate for use as rapid diagnostic probes in agriculture; derive new estimates of similarities and differences from DNA data and compare with estimates based on protein pattern data.

65.027* CRIS0023614
NEMATODE COLLECTION AND SYSTEMATICS

FERRIS V R; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.
Proj. No.: IN0058020 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To continue to develop testable hypotheses of evolution in time and space for selected groups of free-living and plant parasitic nematodes. To continue development of the Purdue Nematode Collection as a basis for research.

Approach: Obtain data on morphological, behavioral and macromolecular characters for variability in populations and species of selected taxa, reevaluate species limits, and analyze by cladistic methods to develop phylogenies and to determine whether geographic distributions should be interpreted as the result of vicariance patterns or dispersal. Continue with curatorial care of the Purdue

Nematode Collection, and make new collections as necessary to provide experimental materials and for management of pest species.

Progress: 86/10 to 87/09. Considerable progress was made in the comparative analysis of 2-dimensional (2-D) protein patterns in free-living nematode species of the Dorylaimida. Among 6 geographical isolates in the genus Labronema the 2-D protein patterns for 2 isolates from Indiana were found to be nearly identical to the pattern for L. vulvapapillatum from Europe. Morphological and life history data subsequently verified the conspecificity of these three isolates. The pattern for a nominal isolate of L. pacificum from south Florida was very different from the patterns of nominal L. pacificum isolates from Hawaii and Fiji, which had patterns very similar to each other, although a few differences in small spots distinguished the two Pacific isolates from each other. In a Jaccard analysis to obtain a quantitative estimate of the phenetic similarity among the isolates, the European isolate had a similarity coefficient (SC) of 0.932 with the 2 Indiana isolates, which were identical to each other (SC = 1.000). The SC for the 2 Pacific isolates was 0.887. The Florida isolate had a much lower pairwise SC with all the other isolates,ranging from 0.333 to 0.389. The Florida isolate had a lower SC with the Pacific isolates than with the isolates of L. vulvapapillatum, even though it had originally been considered conspecific with the Pacific isolates based on morphological data.

Publications: 86/10 to 87/09

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic concepts and methods. Pages 346-353 in J.A. Veech and D. W., Dickson, eds. Vistas on Nematology. 25th Anniversary volume of the Society of Nematologists.

FERRIS, V.R. and FERRIS, J.M. 1987. Two-dimensional protein patterns in Heterodera avenae. Revue Nematologie 9:295-296.

FERRIS, V.R., FERRIS, J.M. and FAGHIHI, J. 1987. Two-dimensional protein patterns of strains and pathotypes in Heterodera avenae. J. Nematol. (in press).

FAGHIHI, J., FERRIS, J.M. and FERRIS, V.R. 1987. Relationship between greenhouse and field susceptibility tests of SCN resistant soybean lines. J. Nematol. (in press).

FERRIS, V.R., FERRIS, J.M., MURDOCK, L.L. and FAGHIHI, J. 1987. Two - dimensional protein patterns in Labronema, Aporcelaimellus and Eudorylaimus (Nematoda: Dorylaimida). Journal of Nematology (in press).

FERRIS, V.R. and FERRIS, J.M. 1987. Phylogenetic analyses in Dorylaimida using data from 2-D protein patterns. J. Nematol. (in press).

65.028 CRIS0133331
2-D PROTEIN PATTERNS IN CYST NEMATODES

FERRIS V R; Entomology; Purdue University, West Lafayette, **INDIANA** 47907.

Proj. No.: IND058020-G Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 87 to 31 AUG 89

Objectives: To compare two-dimensional (2-D) protein patterns among geographically separated isolates of species of agriculturally important cyst nematodes in order to better understand the relationships among nominal races, strains and pathotypes of these pests of crop plants. PROJ. 8700654.

Approach: Obtain data on 2-D protein patterns by radiolabeling protein samples from appropriate experimental materials, followed by two-dimensional polyacrylamide gel electrophoresis (2-D PAGE), location of labeled proteins on gels by fluorography, analysis of similarities and differences in proteins among patterns, and computation of quantitative estimates, based on the protein data, of similarities, differences & relationships among the pest populations.

65.029 CRIS0140447
IDENTIFICATION, METABOLISM AND BIOACTIVITY OF MOLTING AND JUVENILE HORMONES OF NEMATODES

CHITWOOD D J; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-039-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 MAR 86 to 01 MAR 91

Objectives: To isolate and identify molting and juvenile hormones from free-living and plant parasitic nematodes, such as root-knot, reniform and root lesion nematodes; to study steroid metabolism in these nematodes; to develop bioassays for evaluating effects of hormones on nematode life processes.

Approach: Ecdysteroids (insect molting hormones) and juvenile hormones will be isolated and identified from nematode extracts by column chromatography, high performance liquid chromatography, mass spectrometry and radioimmunoassay. Similar experiments will be performed with radiolabeled hormones and hormone precursors, such as sterols, to elucidate hormone metabolic pathways. The effects of these pathways of selected inhibitors of steroid or hormone metabolism in insects and other organisms will be evaluated. Bioassay systems will be developed to quantify events likely tobe under hormonal control, such as molting, and to evaluate the biological activity of several ecdysteroids, juvenoids and related inhibitors.

Progress: 87/01 to 87/12. We previously demonstrated that nematode growth and reproduction can be inhibited by compounds that disrupt nematode sterol metabolism. During the past year, we performed comparative studies of three races of the root-knot nematodes

Meloidogyne incognita and M. arenaria. The major metabolic transformation performed by females or eggs of these economically important plant parasites was saturation of the sterol nucleus and production of stanols. Ecdysteroids, insect hormones, were not detected in Meloidogyne eggs, either as free ecdysteroids or as polar conjugates. A compound that behaved identically to ecdysone during thin-layer chromatography was not ecdysone; it had a molecular weight of 811 and consisted of a C-27 aliphatic alcohol linked to an unidentified compound. Therefore, if ecdysteroids exist in Meloidogyne eggs, they occur in greatly lower amounts than in other nematodes. Previous efforts to determine whether nematodes biosynthesize ecdysteroids have been inconclusive due to occurrence of ecdysteroids in the nematode food, growth medium or host. We have recently developed, however, an improved ecdysteroid-free medium for growth of free-living nematodes. These fundamental results are of importance to and will be utilized by scientists who are developing new, selective control measures for plant parasitic nematodes based upon disruption of their hormonal or steroid metabolic systems.

Publications: 87/01 to 87/12

CHITWOOD, D.J., LOZANO, R., LUSBY, W.R., THOMPSON, M.J. and SVOBODA, J.A. 1987. Metab. and function of sterols... In: "Ecol. and Metab. of Plant Lipids" (G. Fuller and W. O. Nes, eds.) Amer. Chem. Soc., Wash. D.C. pp. 200-217.

CHITWOOD, D.J., LUSBY, W.R. and SALT, T.A. 1987. Sterol metabolism in the nematodes Panagrellus redivivus, Turbatrix aceti and Caenorhabditis elegans. Comp. Biochem. Physiol. 86B:103-107.

CHITWOOD, D.J., MCCLURE, M.A., FELOLAUFER, M.F., LUSBY, W.R. and OLIVER, J.E. 1987. Sterol composition and ecdysteroid content of eggs of the root-knot nematodes Meloidogyne incognita and M. arenaria. J. Nematol. 19:352-360.

CHITWOOD, D.J. 1987. Inhibition of steroid or hormone metabolism or action in nematodes. In: "Vistas on Nematology" (J.A. Veech and D.W. Dickson, eds.). Society of Nematologists, Hyattsville, pp. 122-130.

HERBERT, E.W., CHITWOOD, D.J., and SHIMANUKI, H. 1987. Chalkbrood research at Beltsville. Am. Bee J. 127:488-491.

CHITWOOD, D.J., MCCLURE, M.A. and LUSBY, W.R. 1987. Sterols and ecdysteroid content of eggs of Meloidogyne incognita and M. arenaria. J. Nematol. 19:518. (Abstract).

65.030 0144454

BIOCONTROL OF PLANT PARASITIC NEMATODES TO REDUCE GROUND WATER CONTAMINATION FROM NEMATICIDES

MEYER S L F; HUETTEL R N; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-13240-001-000 Project Type: INHOUSE

Agency ID: ARS Period: 01 FEB 89 to 01 FEB 94

Objectives: (1) Identify, isolate, and characterize fungi that are antagonistic to the soybean cyst nematode (SCN). (2) Develop SCN-antagonistic fungi for biocontrol of the SCN by enhancing their virulence, fungicide tolerance, and environmental stability. (3) Evaluate effectiveness of SCN-antagonistic fungi to control the SCN.

Approach: Fungi will be tested for antagonism to soybean cyst nematode. Genetically manipulated strains (mutants induced by ultraviolet light or chemicals) will be evaluated in greenhouse and field plots, along with wild type strains, to determine which fungi are effective against soybean cyst nematode in the soil.

Progress: 89/02 to 89/12. A strain of fungus antagonistic to the soybean cyst nematode was evaluated in greenhouse studies for ability to act as a biological control agent against this nematode in the soil. These studies supplied information on optimal application rates of fungal inoculum and on ability of the fungus to act when applied at planting and as a postplant pesticide. Methods for production of fungal inoculum were improved and new procedures were developed to expedite production of alginated pellets containing the fungal matter. Alginated pellets are used to deliver the fungal inoculum to the soil. Pellets up to one year old were found to contain viable fungal inoculum, indicating that this delivery system may prove useful in commercial applications. Strains of fungi that exhibited increased tolerance to the fungicide benomyl were grown without benomyl present and then studied to determine whether the increased benomyl tolerance persisted. Such tolerance may increase the ability of a fungus to act as biocontrol agent when benomyl is applied as part of an integrated pest management system. Two strains of fungi were also tested in the laboratory for antagonism to the root knot nematode Meloidogyne incognita. An "Invention Reporting and Invention Ownership Form" was approved by the Patent Committee for Biotechnology in June 1989. This research is directed toward finding alternatives to chemical nematicides that have contributed to groundwater contamination.

Publications: 89/02 to 89/12

NO PUBLICATIONS REPORTED THIS PERIOD.

65.031 CRIS0142129

TAXONOMY AND DEVELOPMENT OF NEMATODES FOR BIOLOGICAL CONTROL OF PEST SOIL INSECTS

NICKLE W R; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-050-000 Project Type: INHOUSE

Agency ID: ARS Period: 25 AUG 87 to 24 AUG 91

Objectives: 1) Produce a publication on the taxonomy, biology, and life history of mermithid nematode parasites of agriculturally important insect pests. 2) Identify both insect and plant parasitic nematodes. 3) Discover, develop, and use nematodes as biological control agents for pest soil insects. 4) study

the races of the pine wood nematode and be available as a consultant for action agencies and private industry on the export problem. 5) Cont- inue placing parasitic nematode data on a new computer data system.

Approach: 1) A monograph using up-to-date methods and procedures such as morpho- metrics, scanning electron microscope photographs, and illustrations, will be prepared. 2) Identifications of nematode parasites will be made and new species will be described. 3) Laboratory and field research on nematode parasites of pest soil and mushroom insect pests will be conducted to studyefficacy, host ranges, and formulation. 4) Races and species of the pine wood nematode will be studied using morphometrics, breeding, scanning electron microscope, genetics, and other up-to-date techniques. 5) Development and usage of a new nematode data retrieval computer program will continue.

Progress: 87/01 to 87/12. The use of nematodes for the biological control of insect pests has the potential of reducing the need for chemical control measures. A new nematode parasite of the imported fire ant was studied and described for the first time. Originally discovered in Brazil by scientists there, this nematode kills over 25% of the ants in colonies in Brazil and thus appears to have potential as an important biological control agent. In cooperation with two other scientists working in the area of biolgical contrcl, guidelines were developed for the importation and introduction of exotic nematodes to be used in the biological control of insect pests. The nematode Steinernema feltiae has potential for controlling mushroom flies currently causing significant damage in commercial mushroom houses. Tests conducted on the efficacy of this means of control resulted in 80-95% kill rate of the flies. Problems were encountered in qualifying the number of insect eggs and maintaining adequate moisture conditions during tests. These nematodes are commercially available at relatively low cost and can be stored and transported efficiently.

Publications: 87/01 to 87/12

NICKLE, W.R., JOUVENAZ, D.P. 1987. Tetradonema solenopsis n. sp. (Nematoda: Tetradonematidae) parasitic on the red imported fire ant, Solenopsis invicta Buren, from Brazil. J. Nematol. 19:311-313.

65.032 0143396
NEMATODES FOR BIOCONTROL OF PEST INSECTS AND TAXONOMY OF INSECT PARASITIC NEMATODES

NICKLE W R; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-063-00D
Project Type: INHOUSE
Agency ID: ARS Period: 26 JUL 89 to 26 APR 90

Objectives: 1) Develop new and existing strains of the nematodes Steinernema and Heterorhabditis for the control/management of soil and foliar pest insects. 2) Develop new technologies for delivering and maintaining infective stage nematodes to control/manage soil and foliar insects. 3) To improve, modernize and stabilize the classification of the insect parasitic groups.

Approach: 1) Laboratory, greenhouse and field experiments with some of the 32 species and strains of the Steinernematid nematodes to control/manage insect pests such as the corn rootworm, Colorado potato beetle, and mushroom fly. 2) Water suspensions of nematodes will be used for mushroom flies. Anti- desiccants and UV blocks will be used on foliar insects and new pelletized formulations will be developed as delivery systems for pest soil insects. 3) To produce up to date taxonomic revisions of the important insect parasitic nematode groups.

Progress: 89/07 to 89/12. A taxonomic revision of the Aphelenchina, a large group of nematodes parasitic on plants, insects and fungi, was completed with Dr. David Hooper of the Rothamsted Experimental Station, England. The five Families and thirty-two genera were described and illustrated. Research was reported on control of the mushroom fly and an insect parasitic nematode. There was an 85% reduction of fly larvae when the nematodes were added at the rate of 620 nematodes per square centimeter. The highest control was achieved when the nematodes were added at the beginning of the third larval insect instar. Work will continue in a commercial mushroom house. Cooperative research with Dr. Connick, ARS New Orleans, on the development of a pelletized formulation as a delivery system for steinernematid nematodes to control pest soil insects was begun. A recent formulation showed that about 45% of the nematodes survived storage and were in healthy condition. The goals are to achieve a survival rate of 75% nematodes with this formulation. Research continues with Dr. W. W. Cantelo on spraying insect parasites nematode in an antidesiccant on foliage to control the Colorado potato beetle. This work is being carried out in a growth chamber and in small field plots.

Publications: 89/07 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

65.033 CRIS0047286
BIOLOGICAL CONTROL OF INSECT PESTS USING INSECT PARASITIC NEMATODES

NICKLE W R; Agricultural Research Service; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-046-00D
Project Type: INHOUSE
Agency ID: ARS Period: 08 SEP 81 to 08 SEP 86

Objectives: To test the feasibility of utilizing mermithids and other insect parasitic nematodes to control economically important insects with particular emphasis on control of agricultural insects such as: Colorado potato beetles, and corn root worms. In cooperation with entomologist, evalute safety of the insect parasites for release, and attempt to establish specific parasites of the Colorado potato beetle and corn root worm under experimental

field condition.

Approach: Find and evaluate insect parasitic nematodes as biological control agents. Determine the host specificity and safetu with which these nematodes can be released into new areas. Rear insect parasitic nematodes, for biological studies and for caged and field released. Taxonomic and basic life cycle studies will be made on nematodes which appear to have potential for biological control of pest insects.

Progress: 86/01 to 86/12. An abstract of a research paper was published describing a new species of nematode, Tetradonema solenopsis, parasitic on the red imported fire ant, an important medical and agricultural pest. This nematode was found in Brazil and killed at least 25% of the ants in the colonies studied. It is a candidate for biological control. Preliminary results on the use of steinernematid nematodes on mushroom flies showed that control rates of 80-95% could be achieved. These nematodes can be purchased commercially. More extensive tests will be conducted in mushroom houses in cooperation with Dr. W. W. Cantelo. These results are of potential importance to the APHIS/State fireant program and to the American Mushroom Institute.

Publications: 86/01 to 86/12

NICKLE, W. R. and JOUVENAZ, D. P. 1986. A new species of Tetradonema parasitic on the red imported fire ant from Brazil. J. Nematol. 19(4): 63.

65.034* CRIS0049511

HOST-PARASITE RELATIONS OF CYST AND ROOT-KNOT NEMATODES ON SUSCEPTIBLE & RESISTANT CROP PLANTS

ENDO B Y; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-027-00D

Project Type: INHOUSE

Agency ID: ARS Period: 01 MAY 85 to 01 MAY 90

Objectives: Determine the 1) ultrastructure of the esophageal region of early develop- mental stages of the soybean cyst nematode (SCN); 2) structure and functionof hypodermal tissue; 3) interaction between esophageal glands and feeding apparatus; and 4) in vivo host response to feeding.

Approach: Electron micrographs will be made of the stylet regeneration of 3- to 6-dayold infective larvae of SCN to determine the regeneration of new stylets during molt. The ultrastructure of the hypodermis will be observed to determine its role in cuticle separation and regeneration during molt. These projects will integrate the newly discovered concepts of Tylenchid stylet regeneration to that of the hypodermis related molting process. Host-parasite interactions at the ultrastructural level should provide clues as to the sequence of changes that occur in host cells of susceptibleand resistant cultivars during feeding and growth of the SCN. Video-enhanced imaging of light microscope observations will be supported by previous and current ultrastructural data of nematodes and their host responses. These data of enhanced images will permit observations of organelle movements that may provide clues to a greater understanding of host-parasite interactions and their disruption in nematode control programs.

Progress: 87/01 to 87/12. Research was conducted on the ultrastructure of the infective and parasitic stages of the soybean cyst nematode, Heterodera glycines, with emphasis on the esophageo-intestinal and intestino-rectal valve as related to food ingestion, digestion, and expulsion. The presence of microvilli-like membrane folds and distinctive enteric coating materials of surface membranes in the intestinal lumen of various stages of the nematode was observed. The lumen was partially blocked by the dense accumulation of the microvilli-like membrane folds after feeding commenced. Noncuticularized membranes of apical surfaces of cells of the esophageo-intestinal and intestino-rectal valves regulate the passage of ingested food and expulsion of waste products. Junctional complexes occurred between the lateral membranes of cells forming the esophageo-intestinal valve, the intestinal epithelium, and the intestino-rectal valve. Muscle fibers were associated with the intestino-rectal valve. Current research focused on the ultrastructure of the esophagus of the root-knot nematode, Meloidogyne incognita. The research has provided new fundamental information on nematode morphology and host-parasite relations. This information will be useful to plant pathologists and others in the search for alternate methods for controlling nematodes.

Publications: 87/01 to 87/12

ENDO, B.Y. 1987. Histopathology and ultrastructure of crops invaded by certain sedentary endoparasitic nematodes, In: Vistas on Nematology. J. Veech and D. Dickson (eds). E.O. Painter Printer Co. DeLeon Springs, Florida. 196-210.

ENDO, B.Y. 1987. Ultrastructure of esophageal gland secretory granules in juveniles of Heterodera glycines. J. Nematol. 19:520. (Abstract).

ENDO, B.Y. 1987. Ultrastructure of esophageal secretory granules in juveniles of Heterodera glycines. J. Nematol. 19:469-483.

65.035 CRIS0049385

SYSTEMATICS, MORPHOLOGY, AND IDENTIFICATION OF CYST, ROOT-KNOT AND RELATED PLANT NEMATODES

GOLDEN A M; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-048-00D

Project Type: INHOUSE

Agency ID: ARS Period: 30 APR 85 to 30 APR 90

Objectives: Develop new data and information on the systematics, morphology, and identification of important groups of plant nemataodes of the suborders Tylenchina and Dorylaimina with primary emphasis on cyst, root-knot and certain related forms; and further develop the taxonomic resources necessary for conducting this research.

Approach: Describe several new species in the selected nematode groups; clarify the Meloidogyne graminis species complex; develop new morphometric data and illustrations on certain root-knot and cyst forms; and synthesize a new or improved key and classification systems with predictive value for certain nematode groups. Curate and expand for taxonomic research and reference purposes the USDA Nematode Collection; and provide accurate identificationsof nematodes for various Federal and State agencies and scientists for research, regulatory, and control purposes.

Progress: 87/01 to 87/12. A new species of root-knot nematode on turfgrass in Maryland was found to be a species within the Meloidogyne graminis complex of species and was described; this provides a sound basis for testing turfgrasses for resistance to these individual species. Study of dagger nematodes, which transmit plant viruses and attack fruit and other economic crops, resulted in description of a new species, redescription of the American dagger nematode with elucidation of its variations, and clarification of relationships of several other forms. These results provide means for accurate identification of these virus-vector nematodes which is critical for research and control purposes. Morphometric and photomicrographic data obtained on bacterial spore parasites observed on various kinds of nematodes indicated that several species of bacterial spore parasites are involved and are more host specific than thought. Previously these parasites, widely used in biocontrol research on nematodes, were viewed as one species with a wide host range. This will expedite biocontrol research by allowing workers to use single species rather than unknowingly, a complex of species. Nematodes from about 300 samples from various federal and state agencies and foreign countries were identified for research, regulatory and control purposes, revealing new species, hosts and occurrences. The USDA Nematode Collection now has 27,546 slides and vials with specimens.

Publications: 87/01 to 87/12

GOLDEN, A.M., MAQBOOL, M.A. and HANDO, Z.A. 1987. Descriptions of two new species of Tylenchorhynchus Cobb, 1913 (Nematoda:Tylenchida), with details on morphology and variation of T.claytoni. J. Nematol. 19:58-68.

JAFFEE, B.A., NYCZEPIR, A.P. and GOLDEN, A.M. 1987. Criconemella spp. in Pennsylvnaia peach orchards with morphological observatons on C. curvata and C. ornata. J. Nematol. 19:420-423.

JEPSON, S.B. and GOLDEN, A.M. 1987. Meloidogyne marylandi n.sp.(Nematoda: Meloidogynidae) a root-knot nematode parasitising grasses. C.A.B. International, Wallingford, Oxon, United Kingdom. Pp 263-265.

LAMBERTI, F. and GOLDEN, A.M. 1986. On the identity of Xiphinema americanum sensu lato in the nematode collection of Gerald Thorne with description of X. thornei sp.n. Nematol. medit 14:163-171.

SAYRE, R.M. and GOLDEN, A.M. 1987. Morpholgical differences of endospores among members of the Pasteuria penetrans group parasitizing nematodes. J. Nematol. 19: 555. (Abstr.).

WEHUNT, E.J. GOLDEN, A.M., WEAVER, C.F. and RODRIQUEZ-KABANA, R. 1987. First report of a Tylenchulus sp. on peach in Alabama, Arkansas, Georgia, and South Carolina. Ann. Appl. Nematol. 1: 127-128.

65.036 CRIS0140352

TAXONOMY OF IMPORTANT NEMATODE GENERA

NICKLE W R; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-047-00D
Project Type: INHOUSE
Agency ID: ARS Period: 31 JUL 85 to 31 JUL 90

Objectives: The objectives of this research are to 1) improve, modernize and stabilize classification & identification of the genera Aphelenchoides, Ditylenchus, Anguina, & insect parasites by revising the groups with descriptions of newspecies, 2) redescribe the insect parasitic genus Bolbinium & review the genus Hexamermis, 3) develop a new computer data retrieval system to managetaxonomic names, data, hosts & literature, & 4) study the effect of myco- phagus aphelenchs & ditylenchs on pathogenic fungi.

Approach: 1) Revise the genera Aphelenchoides, Ditylenchus, and Anguina and describe new species. 2) Redescribe the insect-parasitic genus Bolbinium from new specimens found in Florida. 3) Develop a new computer Telex Database II retrieval system to manage taxonomic names and literature. 4) Measure the effects of the mycophagus nematodes of the genera Aphelenchoides and Ditylenchus on the plant pathogenic fungi Rhizoctonia, Fusarium, and Verticillium in culture.

Progress: 87/01 to 87/12. The presence of pinewood nematode has been the cause of severe restrictions on the exportation of wood chips from the United States to the Scandinavian countries. This ban on the export of wood chips and lumber could result in the loss of millions of dollars in export revenue. Taxonomic studies on the pinewood nematode were conducted to describe morphological differences between geographical races of this organisms. Using scanning electron micrographs morphometric studies were conducted to describe the organisms from France, Norway, and Minnesota. If these organisms can be shown to be the same species, the ban could be lifted. In cooperation with the U.S. Forest Service and industry representatives, a position paper on this problem was written. These findings and the paper should assist export of pinewood

shavings from the U.S. Identifcations of nematodes were made as requested by agricultural scientists at a rate of about one sample every two weeks. From each sample a number of nematodes may be extracted. Permanent slides of insect nematodes were made and deposited in the USDA Nematode Collection.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

65.037 CRIS0049456
INTERRELATIONSHIPS OF PLANT-PARASITIC NEMATODES AND THEIR NATURAL ENEMIES

SAYRE R M; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-024-00D
Project Type: INHOUSE
Agency ID: ARS Period: 15 APR 85 to 15 APR 90

Objectives: To isolate, catalog, and study soil microorganisms which aggressively attack plant-parasitic nematodes and to determine the edaphic factors influencing their survival and beneficial activities. In particular, to investigate separately and in combination the interactions of antagonists with pest nematode populations and develop techniques and practices which permit their utilization as biocontrol agents (natural nematicides) in agricultural production systems.

Approach: Biocontrol agents isolated by appropriate sampling and laboratory techniques will be assayed for their nematicidal effectiveness and suitability for field applications. Their behavior or interrelationships (e.g. attrac-tion, penetration, and colonization of host nematodes) will be observed, recorded and analyzed. The role of environmental stress factors on nema- tode susceptibility to parasitism and on the mechanism governing the antagonist-nematode interactions will be investigated.

Progress: 87/01 to 87/12. Some species of soil fungi and bacteria that are natural enemies of plant-parasitic nematodes have been isolated and evaluated for their efficacy as potential biological control agents. The more promising agents were retained for developmental studies or for further biocontrol research. Strains that act as biocontrol agents in laboratory studies may eventually be used by growers to suppress nematode populations. A bioassay technique was developed for testing the potential of fungi to act as biocontrol agents of soybean cyst nematode. Stains were evaluated to determine which reliably distinguished eggs that had been killed by fungi from viable nematode eggs, and one of these stains was then used in the bioassay. Three fungi caused a statistically measureable decrease in the percentage of live eggs, and other fungi affected eggs to a lesser extent. Ten fungi exhibiting biocontrol potential were inoculated onto agar containing benomyl to determine the level of tolerance each fungus has to this fungicide. Cultivation of Pasteuria penetrans, a bacterium and a possible biocontrol agent of plant nematodes, was pursued through nutritional studies. A few of the experimental media appear to support modest growth of some of the bacterial isolates.. Electronmicroscopy studies of the fine structure of a Pasteuria species isolated from Heterodera glycines revealed a group of characteristics that distinguish this bacterium from others in its group.

Publications: 87/01 to 87/12

KRECEK, R.C., SAYRE, R.M., ELS, H.J., VAN NIERKIRK, J.P.and MALAN, F.S. 1987. Fine structure of a bacterial community associated with Cyanthostomes of zebras. J. Nematol. 19(4):537. (Abstract).

KRECEK, R.C., SAYRE, R.M., ELS, H.J., VAN NIERKIRK, J.P. and MALAN, F.S. 1987. Fine structure of a bacterial community associated with Cyanthostomes (Nematoda: Strongylidae) of zebras. Proc. Helmintho. Soc. Wash. 54(2):212-219.

MEYER, S.L.F. and SAYRE, R.M. 1987. Isolation and evaluation of selected fungal species potentially pathogenic on soybean cyst nematodes. J. Nematol. 19(4):543-544. (Abstract).

REISE, R.W., HUETTEL, R.N. and SAYRE, R.M. 1987. Use of carrot callus tissue in culturing endoparasitic nematodes. J. Nematol. 19(3):387-389.

SAYRE, R.M. and GOLDEN, A.M. 1987. Morphological differences of endospore among members of the Pasteuria penetrans group parasitizing nematodes. J. Nematol. 19(4):555. (Abstract).

SAYRE, R.M., WERGIN, W.P., ENDO, B.Y., and STARR, M.P. 1987. Ultrastrcture comparison of Pasteuria penetrans a bacterial parasite of Meloidogyne incognita and a related parasite of Pratylenchus brachyurus. J. Nematol. 19(4):555-556. Abst.

65.038 CRIS0082477
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

ZUCKERMAN B M; Plant Pathology; University of Massachusetts, Amherst, **MASSACHUSETTS** 01003.
Proj. No.: MAS00492 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Using the principles of IPM, develop integrated nematode management program designed to minimize crop yield losses, environmental contamination and human health risk.

Approach: Our approach has been to intervene with the chemoreceptors and recognition of chemotactic signals by plant nematodes. Experimentally we have been able to inhibit food-finding behavior of a bacteria-feeding nematode model. Receptor blocking experiments gave significant control of root knot nematodes in greenhouse trials. Our immediate objectives are to move these trials to microplots, then to field experiments. Biocontrol experiments encompass an endoparasitic nematophagous fungus, Meria Coniospora, previously not studied.

Progress: 86/10 to 87/09. Three preservation techniques and three cryoprotectants were tested for efficacy in treating conidia of the endoparasitic nematophagous fungus Drechmeria coniospora, the nematodes Caenorhabditis elegans or Panagrellus redivivus, or these nematode species previously infected with this fungus. Significant delay in infection of nematodes from conidia adhering to their cuticles occurred following exposure of conidia to freeze-drying, -80 or -170 storage. These observations support a previous hypothesis that different mechanisms are operative in the events associated with adhesion of the conidia to the nematode cuticle and activities related to penetration of the nematode cuticle and colonization by the fungus. Nematodes did not survive freeze-drying. Low rates of survival of nematodes alone, the fungus alone and fungus-infected nematodes were achieved in most of the techniques tested, but greater efficacy is required for practical delivery aimed at biological control of plant parasitic nematodes.

Publications: 86/10 to 87/09

ZUCKERMAN, B.M., DICKLOW, M.B., COLES, G.C. and JANNSSON, H.-B. Cryopreservation studies of the nematophagous fungus Drechmeria coniospora. Revue de Nematologie (in press).

65.039 0150054

DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT PARASITIC NEMATODES

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL01584 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Research to determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods. Research on the development of improved tactics for nematode management, with special reference on biological and cultural controls. Research to evaluate the integrated nematode management programs designed to minimize crop yield losses, environmental contamination and human health risks.

Approach: Hatching of Heterodera carotae will be studied using root exudates from both healthy and Meloidogyne hapla - infected plants. Rhizoplane bacteria will be evaluated as biological control agents for the H. carotae - carrot, Pratylanchus penetrans - potato, and H. glycines - soybean systems. Crop rotation studies will be used for development of cultural controls for P. penetrans in potato production. cDNA and monoclonal antibody probes will be developed and evaluated for detection of tomato ringspot virus in Xiphinema americanum. Ultrasensitive assay procedures will be compared to existing polyclonal assays using materials from commercial sweet cherry orchards.

65.040 CRIS0099306

BURSAPHELENCHUS XYLOPHILUS PINEWILT: PATHOTYPES AND STRESS CHEMICAL RESPONSE

BOLLA R I; WINTER R E K; Biology; University of Missouri, St Louis, **MISSOURI** 63121.
Proj. No.: MOR-8600189 Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 86 to 28 FEB 89

Objectives: PROJECT 8600189. The proposed research is designed to investigate involvement of phytotoxins in pinewood nematode induced pine wilt and the effect of environmental stress on induction susceptibility of pines to this disease. Several pine species will be exposed to acid rain, drought or heavy metal stress and inoculated with an incompatible pathotype of Bursaphelenchus xylophilus. These pines will be assayed for host response including production of pine wood nematode specific phytotoxins. The phytotoxins will be characterized chemically.

Approach: Two-three year old seedlings of several pine species will be grown in the greenhouse and exposed to acid precipitation, heavy metals or drought under controlled conditions. These seedlings will be incoculated with the white pine specific pathotype of B. xylophilus and observed daily for wilt symptoms. At intervals post inoculation seedlings from each experimental group will be assayed for water flow, abcisic acid production, carbohydrate content and infection specific monoterpenes. Each monoterpene extract will be characterized by TLC, hplc and GC-MS. Control seedlings will be non-stressed nematode incoulated seedlings, non-stressed seedlings inoculated with sterile saline and stressed seedlings inoculated with sterile saline.

Progress: 87/09 to 88/08. Susceptibility of pines to infection with pinewood nematode, Bursaphelenchus xylophilus (PWN) is influenced by the physiological status of the pine and by host specificity of the pathotype of PWN and is associated with the pine's ability to elicit a hypersensitive response to the nematode. Pine seedlings react to simulated acid rain (SAR) or heavy metals by decreased carbohydrates and increased oleorsins. Scots pine exposed to SAR or heavy metals loses tolerance to PWN pathotype, VPSt-1. SAR conditions have no effect on resistance of Austrian pine, however, Austrian pine seedlings exposed to heavy metals lose resistance. Loss of resistance and tolerance in Austrian and Scots pine seedlings is accompanied by decreased carbohydrates, synthesis of phytotoxic oleoresins, and leaf chlorosis. PWN, maintained in fungal culture, loses pathogenicity. Energy metabolism differs among parasitic and nonparasitic isolates of PWN. Parasitic forms excrete glycerol and succinate or lactate as end products of metabolism, whereas nonparasitic forms produce ethanol as the major end product. Analysis of metabolic enzyme activity suggests that nonparasitic isolates and species metabolize carbohydrate via the Embden-Myerhof pathway, whereas parasitic forms use PEP-succinate pathway of metabolism. Abietic acid is a predominant resin acid in healthy seedlings, however dehydroabietic acid becomes predominant following PWN inoculation.

Publications: 87/09 to 88/08

HUBER, M.C. 1987. Copper and lead stress in pines trees infected with Bursaphelenchus xylophilus. M.S. Thesis, Department of Biology, UM-St. Louis.

KOZLOWSKI, P. 1987. Carbohydrate catabolism in the pinewood nematode Bursaphelenchus xylophilus. M.S. Thesis, Department of Biology, UM-St. Louis.

BOLLA, R.I., WEAVER, C., KOZLOWSKI, P., FITZSIMMONS, K. and WINTER, R.E.K. 1987. Characterization of a nonparasitic isolate of Bursaphelenchus xylophilus. J. Nematol. 19:301-306.

BOLLA, R.I., FITZSIMMONS, K. and WINTER, R.E.K. 1987. Carbohydrate concentration in pines as affected by Bursaphelenchus xylophilus inoculation. 19:51-58.

BOLLA, R.I., WEAVER, C. and WINTER, R.E.K. 1987. Genomic differences among pathotypes of Bursaphelenchus xylophilus and in B. mucronatus. J. Namatol. in press.

BOLLA, R.I., KOZLOWSKI, P. and FITZSIMMONS, K. 1987. Carbohydrate metabolism of Bursaphelenchus xylophilus and B. mucronatus. J. Nematol. in press.

FITZSIMMONS, K. and BOLLA, R.I. 1987. Effect of simulated acid rain on development of Bursaphelenchus xylophilus infections. J. Nematol. submitted 11/87, MS 710.

65.041 0139303

TRANSPOSABLE GENETIC ELEMENTS IN SOIL NEMATODES

COLLINS J J; Biochemistry; University of New Hampshire, Durham, **NEW HAMPSHIRE** 03824.
Proj. No.: NH00344 Project Type: HATCH
Agency ID: CSRS Period: 14 SEP 89 to 31 AUG 92

Objectives: To identify additional transposable elements that might be active in the genome of C. elegans, to determine the complete nucleotide sequence of a copy of each new element and to detect RNA transcripts homologous to element encoded upon reading frames identified in Objective 2.

Approach: To identify new transposon families, we will clone novel insertions in the unc-22 gene, determine their genomic copy number and test for homology with known C. elegans transposons. The DNA sequence of each new element will be examined for open reading frames (ORF) that might encode transposade functions. We will also compare the sequences of the termini of each element and the genomic sequences surrounding sites of insertion and excision of each. To test for expression of element-encoded ORFs we will use sensitive approaches including primer extension and polymerase chain reaction techniques to detect predicted RNA species.

Progress: 89/01 to 89/12. Identification of Additional C. elegans Transposons We are analyzing two novel insertions in the unc-22 gene to determine if they represent previously uncharacterized C. elegans transposons. To test this hypothesis, we have asked if the mutations caused by these insertions are unstable. Both revert to wild type at high frequency (greater than 10). Experiments are in progress to determine if reversion is caused by loss of the insertion from unc-22 (excision of the putative transposon). DNA Sequence Analysis The complete nucleotide sequence of the newly discovered transposable element Tc3 has been determined. Two features of this sequence are noteworthy. First, Tc3 has 450 base pair inverted repeat termini (IR). As described previously (Collins et al. 1989, Genetics 121 47-55), the most terminal nine nucleotides are nearly identical to the terminal nine nucleotides of the C. elegans transposon Tc1. However, the overall length of the Tc3 IR is considerably longer than the 54 base pair IR of Tc1, and rather long for members of the class of eukaryotic transposons that have short inverted repeats at their ends. Second, the internal sequence of Tc3 contains a single long open reading frame (ORF) capable of encoding a protein of 319 amino acids. This predicted protein contains regions of significant amino acid identity with the protein predicted by an ORF of approximately the same size contained in Tc1. The functional significance of these structural features is under investigation.

Publications: 89/01 to 89/12

NO PUBLICATIONS REPORTED THIS PERIOD.

65.042 CRIS0131987

GENETIC IMPROVEMENT AND ANALYSIS OF THE ENTOMOPARASITIC NEMATODE, STEINERNEMA FELTIAE

GAUGLER R; OERTLE J; Entomology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ08520 Project Type: CRGO
Agency ID: CRGO Period: 01 JUL 87 to 30 JUN 89

Objectives: PROJ. 8700306. Assess the extent of naturally occurring genetic variability. Bidirectionally select for lines showing: enhanced vs. inferior host-seeking capabilities. Tolerance vs. intolerance to ultraviolet radiation. Determine genetic basis for differences in selected traits.

Approach: Our approach to overcoming the environmental sensitivity of Steinernema feltiae would be to genetically select lines that are less vulnerable to environmental extremes. The feasibility of using genetic improvement techniques to enhance the field effectiveness of biological control agents, however, has not been demonstrated. Previous failures may be a result of releasing what are essentially "domesticated" natural enemies (i.e., lab reared) as inoculative agents where "wild" attributes necessary for establishment must be preserved. This contradiction might be reconciled by applying genetic improvement to inudative agents like S. feltiae since establishment is not expected and the natural enemy need only retain those traits necessary to finding and attacking the target pest.

65.043 CRIS0130402
ENTOMOPATHOGENS FOR USE IN PEST MANAGEMENT SYSTEMS

GAUGLER, R; Entomology & Economic Zoology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJO8251 Project Type: HATCH
Agency ID: CSRS Period: 01 SEP 86 to 30 SEP 89

Objectives: Evaluation and optimigation of the efficacy of insect pathogens.

Approach: Important traits determining the efficacy of the entomogenous nematode Steinernema feltiae as a biological control agent will be genetically enhanced. Target characteristics will include host-seeking ability and tolerance to solar radiation and desiccation. Maximum genetic variability will be solicited and trait variability assessed. Breeding strategies will include conventional mass selection, convergent breeding and heterosis. Biometrical genetic analysis of improved strains will be conducted, and validation performed under field conditions.

Progress: 87/01 to 87/12. Genetic selection of the entomopathogenic nematode Steinernema feltiae for enhanced host-seeking capability over ten generations has resulted in a 10-fold increase in host attraction. That is, the proportion of infective stage nematodes capable of orienting and migrating a distance of 3.5 cm to an insect larvae in one hour has been increased from less than 5% to more than 50%. Moreover, the proportion of infectives moving in a positive direction (i.e., toward the host) has more than doubled, from 30% to 70%, while immobility (i.e., nematodes not initiating host-seeking movements) has decreased from 37 to 19%. The distance required for maintaining selection pressure has consequently increased from 3.5 cm in the first generation to 22.5 cm in the tenth. This improved strain will be used in biometrical analyses to understand the genetic architecture underlying the selected trait.

Publications: 87/01 to 87/12

GAUGLER, R. 1986. Feasibility of genet'ly improving steinernematid & heterorhabditid nematodes. In "Fund. & Appl. Aspects of Invert. Path" (R.A. Samson, J.V. Vlak & D. Peters, eds., pp. 300-333.Proc. IVth Intern. Colloq. Invert. Pathol. 711 p.

GAUGLER, R. 1987. Non-infectious diseases. In "Epizootiology of Insect Diseases" (J.R. Fuxa and Y. Tanada, eds.), pp. 245-56. John Wiley & Sons, New York.

GAUGLER, R. 1987. Entomogenous nematodes and their prospects for genetic improvement. In "Biotechnological Advances in Invertebrate Pathology and Cell Culture (K. Maramorosch, ed.), pp. 457-484. Academic Press, New York.

65.044 CRIS0094088
GENETIC ANALYSIS OF EARLY EMBRYOGENESIS IN C. ELEGANS

KEMPHUES K J; Genetics Development; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-186417 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 91

Objectives: Continue genetic and phenotypic analyses of the four previously identified loci required for asymmetric cytoplasmic partitioning during early development of C. elegans. Isolate multiple alleles at each locus. Construct double mutants to learn about interactions among the genes. Correlate early and late defects to learn more about the relationship between specific early embryonic events and determination of intestine and germ line. Examine the cellular basis of the maternal-effect sterility exhibited by mutants at three of the four loci. Identify and characterize additional genes required for cytoplasmic localization or determination of the intestine lineage in particular. Isolate DNA encoding genes required for asymmetric partitioning in C. elegans.

Approach: Analyses will include large scale mutant hunts to isolate multiple mutations in each of the four known genes, mutant hunts to identify additional partitioning genes, examination of mutant phenotypes by light microscopy, time-lapse video tape recording, immunocytochemistry, and cell lineage analysis. DNA corresponding to these genes will be isolated by chromosome "walking" and transposon "tagging". In addition, mutant hunts to identify maternal-effect lethal mutants that result in failure to execute the developmental program leading to the formation of intestine will be performed.

Progress: 87/01 to 87/12. We have been continuing our studies of five maternally-acting genes with major roles in cytoplasmic localization in early C. elegans embryos (partitioning genes). Studies of these genes provide a unique opportunity to study the mechanisms by which early embryonic asymmetries are generated. Screens for additional mutations at these five loci have resulted in an increase of mutations from 14 to 31. Phenotypic analysis of the new alleles confirms our previous conclusions about the importance of these genes in asymmetric partitioning of cytoplasm, in the establishment of the early cleavage pattern, and in specification of certain embryonic cell fates (gut and germ line). In an effort to identify genes with which the par genes interact, we have been carrying out reversion screens. We have isolated and begun characterizing seven strains carrying mutations that correct the defective embryogenesis in animals homozygous for par-2 mutations. In addition to studying par genes, we have begun analysis of a locus identified in previously reported screens for maternal-effect lethal mutations on the second chromosome. Our analysis indicates that the gene encodes a product required for chromosome segregation during meiosis. More specifically, our genetic analysis has shown that crossing-over is eliminated or drastically reduced in

homozygotes for mutations at this locus. The phenotypes of the mutants suggest that the gene plays a major and specific role in the process of meiotic recombination.

Publications: 87/01 to 87/12

KEMPHUES, K. J., PRIESS, J. R., MORTON, D. G. and CHENG, N. 1988. Identification of genes required for cytoplasmic localization in early C. elegans embryos. Cell, in press.

KEMPHUES, K. J., PRIESS, J., CHENG, N. and MORTON, D. 1987. ndentification of genes required for cytoplasmic localization in C. elegans. J. Cell. Biochem. Supp. 11C.

MORTON, D. G. and KEMPHUES, K. J. 1987. New mutations affecting cleavage pattern and cytoplasmic localization. Abstracts of the 1987 C. elegans meeting. Unpub.

CHENG, N. and KEMPHUES, K. J. 1987. Further studies of par-2. Abstracts of the 1987 C. elegans meeting. Unpub.

CARTER, P. and KEMPHUES, K. J. 1987. Progress toward cloning zyg-9 and zyg-11. Abstracts of the 1987 C. elegans meeting. Unpub.

65.045 CRIS0099587

BIOLOGY AND ECOLOGY OF PLANT PARASITIC NEMATODES

KO M P; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-153440 Project Type: HATCH
Agency IO: CSRS Period: 01 OCT 86 to 30 SEP 89

Objectives: The overall objective is to investigate the ecology and biology of plant parasitic nematodes in New York State, with relevance to improvement of current integrated control measures for the pests. The specific objectives are (1) to improve current in vitro techniques of mass cultivation of the nematodes; (2) to develop and subsequently use a plant/nematode model system that is amenable to molecular and genetic analysis to answer some of the basic questions of host-nematode interactions; (3) to gain further insights into the ecology of nematodes and their associative microflora through studies in the etiology of nematode associated disease complexes and in the mechanisms of soils suppressive to nematodes.

Approach: Nematodes will be cultured in normal or transformed host organs, tissues, or callus cells, using modern methodologies of tissue culture. The rapid-cycling crucifer, Arabidopsis thaliana - a current model system for plant molecular genetics, will be used as a host to select populations of parasitic nematodes with short generation time. The selected plant/nematode system will be stabilized and used as a model system for further studies of all aspects of host-parasite relationships. The etiology of complex disease and interactions among causal organisms will be studied in growth chamber, microplot experiments and growers' fields.

Progress: 87/01 to 87/12. As a prelude to achieve objectives 1 (to improve current in vitro techniques of mass cultivation of nematodes) and 3 (to gain further insights into the ecology of nematodes and their associative microflora through studies in the etiology of nematode associated disease complexes and in the mechanisms of soil suppressive to nematodes), the suitabilities of the polyol Pluronic F127 to culture nematodes, plant tissues, and soil microorganisms were examined. Pratylenchus penetrans, the most important nematode associated with apple replant disease (ARD), was little affected in terms of infectivity and female/male ratio when cultured in alfalfa callus in 20% w/v polyol media (White's). Rate of population increase of the nematode was sharper and persisted longer in the polyol medium than in agar medium. Other soil organisms such as fungi, actinomycetes, and bacteria were also found not to be affected in various polyol media. Plant seedlings or tissues were differentially sensitive to the polyol, depending on the genotypes. Nevertheless, some of the plant seedlings could be cultured in the polyol medium under high humidity for a brief duration (2 weeks) with no apparent abnormalities. The polyol is therefore suitable for the purpose of culturing P. penetrans for further biological and ecological studies. It may also be used to isolate from ARD soil the potential biological control agents of P. penetrans or the causal agents of ARD.

Publications: 87/01 to 87/12

KO, M.P. and VAN GUNOY, S.D. 1987. An alternative geling agent for culturing and studies of nematodes. J. Nematology (In press).

KO, M.P. and LOOER, E. 1988. Culturing of plant parasitic nematodes and plant tissues in Pluronic polyol media. J. Nematology (In press).

65.046 CRIS0099061

CYTOGENETIC AND BIOCHEMICAL STUDIES IN THE GENUS MELOIDOGYNE

TRIANTAPHYLLOU A C; Genetics; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC03972 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Elucidate interrelationships, improve taxonomy and simplify identification of root-knot nematode species and races through extensive cytogenetic analysis. Obtain sufficient enzymatic data to construct a phyletic tree that will reveal biochemical evolution in the genus Meloidogyne.

Approach: Cytogenetic studies involving gametogenesis and mode of reproduction will be carried out with a large number of populations of root-knot nematodes from many parts of the world. Karyotype analyses will include diploid, polyploid and aneuploid forms with amphimictic or parthenogenetic mode of reproduction. Compatibility of genomes will be tested in experimental hybrids. Selected populations will be studied with regard to many enzymes using thin-slab polyacrylamide gel electrophoresis. A phyletic tree will be constructed on the basis of enzymatic and cytogenetic data.

Progress: 87/01 to 87/12. Cytogenetic studies revealed for the first time actual polyploidization of a diploid, mitotically parthenogenetic species of Meloidogyne. This discovery modifies previous assumptions regarding the pathway of evolution of mitotically parthenogenetic root-knot nematodes, i.e., through direct polyploidization, in addition to hybridization between forms of unequal degree of ploidy. A unique case of pseudo-hermaphroditism was discovered in a sub-population of M. hapla maintained under greenhouse conditions. About 50% of the adult females produce not only oocytes but also spermatozoa which cannot pass through the oviduct into the spermatotheca, and thus remain nonfunctional. This first case of hermaphroditism in Heteroderoidea may elucidate the evolutionary significance of hermaphroditism, gonochorism and thelytokous parthenogenesis encountered in various phylogenetic groups of nematodes. Cytogenetic studies of M. kikuyensis revealed a chromosomal status very different from that of other Meloidogyne species and suggested that this species should be transferred to a different genus. Enzymatic investigations of various populations of Heterodera glycines demonstrated that esterase polymorphism is controlled by a multiallelic system in a single esterase locus. The ability of the nematode to parasitize resistant soybeans is not related to its esterase phenotype.

Publications: 87/01 to 87/12

TRIANTAPHYLLOU, A. C. 1987. Cytogenetic status of Meloidogyne (Hypsoperine) spartinae in relation to other Meloidogyne species. J. Nematol. 19:1-17.

ESBENSHADE, P. R. and TRIANTAPHYLLOU, A.C. 1987. Enzymatic relationships and evolution in the genus Meloidogyne (Nematoda: tylenchida). J. Nematol. 19:8-18.

TRIANTAPHYLLOU, A. C. 1987. Genetics of nematode parasitism on plants. In: Vistas on Nematology. (J.-A. Veech and D. W. Dickson, eds.) pp. 354-363. Society of Nematologists, Inc. Hyattesville, Maryland.

65.047 CRIS0132682

GENETICS OF PARASITISM OF THE SOYBEAN CYST NEMATODE

TRIANTAPHYLLOU A C; ESBENSHADE P R; Genetics; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC09347 Project Type: CRGO
Agency ID: CRGO Period: 01 AUG 87 to 31 JUL 88

Objectives: Proj. 8700338. Construct a genetic linkage map of the H. glycines genome based on isozyme markers. Identify specific genetic factors controlling parasitism in various inbred lines of the nematode and specify their positions on the enzymatic linkage map.

Approach: Selected populations of H. glycines differing in their parasitic abilities and isozyme markers will be subjected to controlled, single-pair matings in order to study mode of inheritance of various enzymes & determine recombination frequencies between enzymic loci. This information will allow determination of linkage groups and development of a genetic map of the H. glycines genome. To this map, specific genes for parasitism will be added following an analysis of the segregation patterns of progeny in controlled crosses of well-defined inbred lines with specific genes for parasitism linked to specific enzyme phenotypes.

Progress: 87/08 to 87/12. Three field populations of Heterodera glycines were found to be polymorphic with regard to esterases. Most females of each population had complex esterase banding patterns, with 3, 4 or more bands. Some females had a simple pattern consisting of two closely-spaced bands. Such females could be classified in three categories according to the relative migration rate of the double bands. The three categories have been recognized as distinct phenotypes designated as A, B and C. A total of 30 lines, homogeneous (nonsegregating) for a particular phenotype have been developed through selection and inbreeding. They represent phenotypes AA, BB and CC that are used in single-pair crosses to study the genetic basis of esterase polymorphism in Heterodera glycines. The ability of each phenotype to parasitize certain resistant soybean breeding lines has been determined.

Publications: 87/08 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

65.048* CRIS0132502

CONTROL AND REGULATORY MECHANISMS IN PLANT-PARASITIC NEMATODES

OPPERMAN C H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC05643 Project Type: STATE
Agency ID: SAES Period: 01 APR 87 to 31 MAR 88

Objectives: Determine mechanisms involved in control of molting in nematodes, characterize neurological systems present in plant-parasitic nematodes and explore functions, create developmental gene libraries from plant-parasitic nematodes at different stages of host-parasite interaction, characterize mRNA enrichment, characterize regulatory mechanisms involved in formation and maintenance of feeding sites in host plants by plant-parasitic nematodes.

Approach: A combination of genetic manipulation and pharmacological perturbation will be utilized to explore biochemical and cellular mechanisms. Caenorhabditis elegans will be used as a model system where appropriate. Genetic analysis and pharmacology will be combined to: use mutations/resistance to understand drug function, use drugs to identify specific gene alterations, and combine 1 and 2 to analyze control and regulatory function. Standard techniques will be used to create libraries and isolate/translate mRNA.

Progress: 87/04 to 87/12. Experiments to compare the acetyl cholinesterase of the nematodes Caenorhabditis elegans and Meloidogyne incognita (root-knot nematode) were initiated. Preliminary results indicate that enzymes from the two nematodes behave similarly in radiometric assays. Responses to classical cholinesterase inhibitors are comparable although M. incognita appears to be slightly more sensitive than C. elegans. Experiments to compare the biochemical and kinetic characteristics of the nematode enzymes are under way. Research has also been started on the acetyl choline receptor in M. incognita. It appears that C. elegans will be a good model for the study of the cholinergic system in M. incognita and other plant-parasites. C. elegans mixed age populations have been screened against a variety of pharmaceutical agents which interact in several different neurological systems and several drugs which interfere with normal behavior and development have been identified. We are currently attempting to isolate the receptor from the system in which one of these drugs interacts. Further efforts will include mutagenesis, further drug testing, and biochemical analysis to try to identify genes involved in regulatory and control systems.

Publications: 87/04 to 87/12
ND PUBLICATIDNS REPDRTED THIS PERIDD.

65.049 CRISO134336
NEURONAL CONTROL MECHANISMS IN NEMATODES

DPPERMAN C H; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NCO6060 Project Type: HATCH
Agency ID: CSRS Period: 01 APR 88 to 30 SEP 92

Objectives: Isolate and characterize molecular forms of acetylcholinesterase from Meloidogyne spp., Heterodera spp., and selected other plant-parasitic nematodes; identify and isolate acetylcholine receptor subtypes from Caenorhabditis elegans and M. incognita; identify molecular components of the GABAergic system in nematodes.

Approach: Molecular forms of acetylcholinesterase will be isolated by a combination of density gradient centrifugation and ion exchange chromatography. Both physical and biochemical properties will be evaluated by standard methods. Response to inhibitors will be investigated. Receptor subtypes will be identified through competitive binding assays for pharmacological characterization. Receptors will be isolated by affinity chromatography. A combination of genetic manipulation and pharmacological perturbation will be used to identify GABAergic system components; we will use mutations/resistance to infer drug function, and drugs to identify specific gene alterations.

65.050 CRISO131463
GENETIC TRANSFORMATION OF A SOIL NEMATODE BY MICROINJECTION OF CLONED DNA

MILLER D M; Zoology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NCO5644 Project Type: STATE
Agency ID: SAES Period: 01 DCT 86 to 30 APR 88

Objectives: The objective of this proposal is to develop a reliable method for inserting genes into the chromosomes of a soil nematode. We intend to employ this technique to identify DNA sequences that regulate the expression of nematode genes. The information to be gained from this project is fundamentally important to our understanding of the genetic specification of nematode development.

Approach: Cloned genes will be microinjected into oocyte nuclei in the gonad of a mature nematode. The host embryo is genetically disabled in such a way that it cannot reproduce unless the injected DNA is incorporated into its genome. Thus, when fertile offspring arise from the injected parent then the exogenous DNA has been successfully inserted into the genome. In this way, nematode genes that have been chemically modified in the laboratory can be assayed for the effects of these changes in vivo.

Progress: 86/10 to 87/12. The principal objective of this project has been to develop an efficient microinjection method for genetic transformation experiments with the nematode, C. elegans. A Nikon inverted microscope was equipped with epifluorescence and Nomarski DIC optics. The Nikon microscope stage was adapted to accommodate a Zeiss motorized micromanipulator. We now have a sophisticated microinjection set up that will be used in several new projects in the laboratory that are designed to clone genes regulating the development and function of the nematode nervous system.

Publications: 86/10 to 87/12
ND PUBLICATIDNS REPDRTED THIS PERIDD.

65.051 CRISO131464
MOLECULAR GENETIC ANALYSIS OF A MYOSIN HEAVY CHAIN GENE EXPRESSION

MILLER D M; Zoology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NCO5645 Project Type: STATE
Agency ID: SAES Period: 01 DCT 86 to 30 JUN 88

Objectives: The objective of this project is to dissect the genetic mechanisms regulating the expression of myosin heavy chain (MHC), a major protein component of muscle. DNA sequences adjacent to a nematode MHC will be analyzed to search for putative regulatory or promoter sites. Mutations that alter these regions and which affect MHC gene expression will be sequenced in order to identify the specific regulatory domains.

Approach: We have designed a genetic scheme that selects for mutants expressing elevated levels of MHC in the nematode. With this approach, we hope to isolate mutations in DNA sequences that regulate MHC expression. The specific lesions associated with each mutant will be determined by DNA sequencing methods.

Progress: 87/01 to 87/12. We have initiated a molecular genetic analysis of the regulation of myosin heavy chain (MHC) gene expression in the nematode, C. elegans. There are four separate MHC genes (A,B,C,D) that are differentially expressed in nematode muscle. We have employed a genetic selection scheme that is specifically designed to isolate mutations that elevate the expression of the MHC A gene. The rationale is to identify cis-acting DNA sequences as well as trans-acting loci that specifically regulate MHC A expression. We have used a blot-hybridization technique to determine that the MHC A gene is amplified in eleven out of 13 mutants that we have analyzed. Therefore, in these cases, enhanced MHC A expression is a direct result of transcription from 2 or more copies of the MHC A gene. In the other two mutants, m292 and m168, MHC A gene copy number is not increased. These mutants will be genetically mapped. If either is closely linked to the MHC A gene (cis- acting) we should be able to determine the DNA sequence of the lesion since the MHC A gene is already cloned. Potential trans- acting loci should be clonable once they are placed on the genetic map given the availability of a recently constructed restriction map of the entire C. elegans genome. We are encouraged by these results and intend to isolate additional mutations that affect MHC A gene expression in our continuing effort to understand the mechanisms regulating muscle gene expression.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

65.052* CRIS0142136
PHYSIOLOGY OF NEMATODES AND THEIR INTERACTION WITH CROP PLANTS

VEECH J A; THOMAS M D; Agricultural Research Service, College Station, **TEXAS** 77843.
Proj. No.: 6202-24000-006-00D
Project Type: INHOUSE
Agency ID: ARS Period: 17 FEB 87 to 16 FEB 92

Objectives: To elucidate the biological activity and chemical composition of nematode stylet exudate from plant parasitic nematode species, activities and chemicals related to host plant susceptibility and resistance and nematode pathogenicity will be emphasized.

Approach: Biological activity of stylet exudate will be assessed by treating host cells with stylet exudate and monitoring cellular responses with a time-lapse VCR linked to an interference contrast microscope. Treated cellswill be analyzed for specific enzymes and natural products using standard histochemical methods; weak responses will be measured with a microspectrophotofluorometer mounted on a visible-fluorescent microscope. Exudate-producing nematodes will be placed in microscope perfusion chambers, and accumulated exudate will be analyzed by microchemical methodsusing the microscope-photometer. Exudate mechanically removed from nematodes will be analyzed by electrophoresis and other micromethods.

Progress: 87/02 to 87/12. Fundamental parameters of in vitro accululation of stylet exudate were worked out and reported in the listed publication. Exudate accumulation was recorded with a VCR, and biological activity studies based upon the topical application of stylet exudate to host cells were conducted. Early stages of giant cell formation were not detected; similar studies, based upon microinjection of stylet exudate into host cells, are scheduled. Efforts to react fluorescent antibodies with stylet exudate antigen were only marginally effective; the fluorescent marker was detected, but not consistently, in stylet exudate accumulated at the oral aperture of M. incognita females excised from tomato roots. Preliminary studies indicate the presence of nucleic acid in stylet exudate; this result is being pursued with additional studies.

Publications: 87/02 to 87/12
VEECH, J.A., STARR, J.L., and NORDGREN, R.M. 1987. Production and partial characterization of stylet exudate from adult females of Meloidogyne incognita. J. Nematol. 19: 463-468.

65.053 CRIS0047580
BASIC NEMATOLOGY RESEARCH

VEECH J A; Agricultural Research Service; Agricultural Research Service, College Station, **TEXAS** 77843.
Proj. No.: 6202-20270-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 05 APR 82 to 17 FEB 87

Objectives: Determine the basic biochemical and physiological mechanisms by which nematodes parasitize plants and plants resist parasitism by nematodes, the ultimate goal of which is to develop improved nematode/control technologies based on such knowledge.

Approach: Physiological and biochemical techniques will be employed to elucidate the nutritional requirements, reproduction chemistry, and mechanisms of parasitism of plant parasitic nematodes. The effects on plant parasitic nematodes of constitutive and induced plant products will be investigated by bioassay and biochemical procedures. Metabolic inhibitors, labeled intermediates, and specific biochemical procedures will be used for comparative studies of nematode infected susceptible, tolerant, and resistant plants. Allelopathic relationships of plants and nematodes will be elucidated.

Progress: 86/01 to 86/12. Stylet exudate collected from adult female Meloidogyne incognita excised from host roots was assayed for its effect on plant cells maintained in

liquid culture. A video camera was linked to an interference contrast microscope, and we were unable to observe an effect of topical application of stylet exudate on host cells. Conditions for micro-injection of stylet exudate into recipient host cells for subsequent VCR monitoring are now being worked out. Previously, antibodies to stylet exudate were produced in healthy white mice subsequently inoculated with a specific tumor cell line. Instead of collecting blood from the mice, tumor fluid is collected; tumor fluid volume is about 20 times the volume of collectable blood, and gives a corresponding increase in yield of the desired antibodies.

Publications: 86/01 to 86/12

STARR, J.L. and VEECH, J.A. 1986. Root-knot nematode susceptibility of cotton putatively resistant to Fusarium wilt-root knot nematode complex. Crop Sci. 23:543-546.

65.054 CRIS0099038
PLANT NEMATODE MITOCHONDRIAL DNA

WOLSTENHOLME D R; Biology; University of Utah, Salt Lake City, **UTAH** 84112.
Proj. No.: UTAR-8600094 Project Type: CRGD
Agency ID: CRGO Period: 01 JUN 86 to 31 MAY 89

Objectives: Proj. 8600094. To devise a diagnostic test for identification of different species and races of root knot nematodes (Meloidogyne species).

Approach: We will determine the entire nucleotide sequence of the mitochondrial (mt) DNA molecule of M. javonica, and from this sequence generate a complete restriction enzyme cleavage map by computer analysis. Restriction maps of other Meloidogyne species (M. arenaria, M. incognita and M. hapla) and races will be made using restriction enzyme cleavage and gel electrophoresis. We will then work out specific conditions to use radioactively-labeled, cloned fragments of M. javonica mtDNA in a capillary blot hybridization procedure to identify the different species and races of Meloidogyne.

Progress: 86/07 to 87/12. We are sequencing the circular mitochondrial (mt) DNA molecule of the root knot nematode, Meloidogyne javanica. Within 12 kb of unique sequence obtained to date, we have identified genes or the two ribosomal RNAs (rRNA), five transfer RNAs (tRNA) and five proteins: cytochrome oxidase subunit I, cytochrome b, respiratory chain NADH dehydrogenase subunits 1, 2 and 5. Comparisons of amino acid sequences of corresponding mt-protein genes of M. javanica, Caenorhabditis elegans, Ascaris suum, Drosophila yakuba and mouse suggest that the ancestral lines that led to M. javanica and C. elegans diverged shortly after the divergence of the main nematode line from the line that lead to insects and vertebrates. Data from M. javanica mt-protein gene sequences indicate that AGA and AG specify serine, and TGA specifies tryptophan in this organisms mt-genetic code. Four of the M. javanica mt-tRNA genes have a secondary structure resembling that of corresponding tRNA genes in A. suum and C. elegans mtDNAs: the T psi C arm and variable loop are replaced with a loop (TV-replacement lop) of 4 to 8 nt. (The remaining tRNA gene, for tRNA(ser)AGN, has a D-arm replacement loop, as does this tRNA in all other metazoa mtDNAs). In view of the apparent ancient divergence of the M. javanica and C. elegans ancestral lines, our data indicate that TV-replacement loop-containing tRNA enes arose before or early in the evolution of nematodes. The M. javanica mt-rRNA gene is the smallest rRNA gene described from metazoa.

Publications: 86/07 to 87/12

ND PUBLICATIONS REPORTED THIS PERIOD.

65.055 CRIS0093138
CHARACTERIZATION OF THE INSECTICIDAL TOXIN OF XENORHABDUS

ENSIGN J C; BOWEN D; Bacteriology; University of Wisconsin, Madison, **WISCONSIN** 53706.
Proj. No.: WIS02867 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: To test the bacterium Xenorhabdus for insecticidal activity and antibiotic activity. The bacterium is a symbiont in the gut of nematodes and is the cause of fatal septicemia of Lepidoptera insects. The bacterium is also known to produce antibacterial agents. Work is focused on a crystalline inclusion formed inside the Xenorhabdus cells because of the known insect toxin that is produced as a protein crystal inside Bacillus thuringiensis.

Approach: Crystals will be isolated from Xenorhabdus cells and tested along with other cell fractions and growth broth for killing of Galleria larvae and antibiotic activity. The crystals will be characterized with respect to solubility and chemical composition. The insect toxin will be tested for lethal effects on a variety of insects and for toxicity to mice and honey bees. If the toxin appears to have potential use, it will be tested in laboratory and field studies for plant protection. The antibiotic will be identified and tested for safety using mice as the test organism.

Progress: 87/01 to 87/12. The crystalline protein inclusion inside the cytoplasm of the insect pathogenic bacterium Xenorhabdus has been purified and characterized. The crystal is made of a single protein with molecular weight 12,500. The amino acid composition is known and the sequence of 30 amino acids determined. The protein is not toxic to insects upon feeding or injection and we have been unable to convert it to a toxin by various treatments, including digestion with insect proteases. An insecticidal toxin with potent activity was detected in the culture broth of the bacterium. This toxin is lethal upon injection to both Lepidopteran and Coleopteran insects. The toxin is a low molecular weight protease and is not related immunologically to the crystal protein. The toxin has been purified by column chromatography and acrylamide gel electrophoresis. Its range of activity and

mechanism of insect killing are being studied.

Publications: 87/01 to 87/12
BOWEN, D. and J.C. ENSIGN. 1987. Crystalline inclusion of the entomaphathogen Xenahabdus luminescens. Abstr. G-181, American Soc. Microbiology. (Abstract).

65.056 CRIS0135363
MIGRATION OF PRATYLENCHUS PENETRANS BETWEEN ROOT AND SOIL HABITATS

MACGUIDWIN A E; Plant Pathology; University of Wisconsin, Madison, **WISCONSIN** 53706.
Proj. No.: WIS03231 Project Type: CRGO
Agency ID: CRGO Period: 01 JUL 88 to 30 JUN 89

Objectives: PROJ. 8800727. To determine if Pratylenchus penetrans can feed as an ectoparasite and successfully develop and reproduce without entering root tissue. To determine the relationship between nematode density, host nutrient status, and egress of Pratylenchus penetrans from roots. To determine if certain intrinsic behaviors or attributes of Pratylenchus penetrans prompt migration from roots.

Approach: Pisum sativum seedlings and root explants will be inoculated with known numbers of P. penetrans in defined life stages. Detailed population data will be collected at frequent time intervals to quantify the distribution and movement patterns of nematodes. Root ingress and egress of nematodes will be directly visualized with a microscope and recorded with a video camera. The effect of nematode population density and host nutrition on nematode migration will be evaluated by altering nematode inocula and plant growth media. The redistribution of nematodes exiting roots will be studied by limiting the inoculation of nematodes to defined segments of the root.

66.001 CRIS0087543
REGULATION OF GENE EXPRESSION IN THE NEMATODE

OTSUKA A J; Genetics; University of California, Berkeley, **CALIFORNIA** 94720.
Proj. No.: CA-B*-GEN-4232-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: To study gene regulation in the nematode Caenorhabditis elegans.

Approach: Utilizing recombinant DNA techniques and Nomarski interference contrast microscopy, studies of mutationally altered gene regulation and development will be carried out.

Progress: 86/01 to 86/12. Our group has been studying the biological processes involved in the growth of neurons in the nematode Caenorhabditis elegans. It is known that mutations in five genes (unc-6, unc-33, unc-44, unc-51, and unc-76) prevent normal connection of axons growing from sensory structures in the periphery to the ganglia of the central nervous system. In particular, we are cloning these genes by physically labelling them with insertions of DNA (transposon tagging). We have shown in preliminary studies that this approach is feasible for a novel dumpy (dpy) gene (that has not been shown to affect neuronal outgrowth), and for unc-44 and unc-104 which do have an abnormal axon phenotype. The unc-44 mutations show clear defects in the growth of axons from the postdeirid neuron cell bodies to the ventral nerve cord. In the case of unc-44, 15 novel restriction fragments were associated with the mutation. Separation of the transposon of interest from flanking transposons by recombination has reduced the number of extra transposons to three. Cloning of these three transposons is underway. Knowledge gained from these studies may be applied to nematicides that affect muscle, nerve or reproductive systems in these organisms.

Publications: 86/01 to 86/12

OTSUKA, A.J., WHEATON, V.I. and HEOGECOCK, E. 1987. Transposon tagging of genes affecting axonal outgrowth in Caenorhabditis elegans, in "Molecular Approaches to Developmental Biology", UCLA Symp. Mol. Cell. Biol., 51, in press.

OTSUKA, A.J. 1986. Possible directions for genetic analysis and modification of nematode species, 4th International Colloquium on Invertebrate Pathology, 296-299.

OTSUKA, A.J. 1986. Sup-3 suppression affects muscle structure and myosin heavy chain accumulation in Caenorhabditis elegans, in "Molecular Biology of Muscle Development" UCLA Symp. Mol. Cell. Biol., 29, 619-628.

66.002 CRIS0065725
QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESS

FERRIS H; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-3757-RRProject Type: HATCH Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extraction methodology for nematode detection and assessment. Oetermination of the relationship between crop losses and nematodes as affected by environmental conditions. Oetermination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: Population distribution parameters are defined for a range of edaphic conditions. Seasonal stability of damage functions will be examined under a range of edaphic conditions. Prediction of population change will allow assessment of optimal cropping sequences for profit maximization.

Progress: 87/01 to 87/12. Objective 1: No activity this period. Objective 2: Population densities of Criconemella xenoplax have been assessed at approximately monthly intervals since August 1985 in a peach orchard at Livingston, CA. Following preplant fumigant, the orchard was planted in February, 1985 in alternating four row strips of Nemaguard and Lovell rootstock. The nematode population stabilized at 21,000 to 28,000 C. xenoplax per liter of soil on Nemaguard by August, 1986. It only approached those levels on Lovell about one year later. Nemacur treatments maintained the population at about 30% of that on the equivalent nontreated rootstock. Cumulative nematode stress dosages are three times higher on Nemaguard than on Lovell rootstock. Yields in August, 1987 were slightly higher on Nemaguard than on Lovell and were higher when plots were not treated with nematicide. However, shoot length, transpiration rates and vigor were slightly higher in the nematicide treated than the nontreated trees. Increased fruitfulness in the absence of nematicides may reflect that the plants are under stress. Three trees have died of bacterial canker, all on Nemaguard rootstock in the absence of nematicides. The fungus Hirsutella rhossiliensis is becombing increasingly prevalent in the field, apparently associated with increased population density of its host, C. xenoplax. Objective 3: No activity this period.

Publications: 87/01 to 87/12

NOLING, J.W. and FERRIS, H. 1987. Nematode-degree days, a density-time model for relating epidemiology and crop losses in perennials. J. Nematol. 19:108-118.

SCHMITT, D.P., FERRIS, H. and BARKER, K.R. 1987. Response of soybean to Heterodera glycines races 1 and 2 in different soil types. J. Nematol. 19:240-250.

FERRIS, H. 1987. Components and techniques of integrated pest management threshold determinations for soilborne pathogens. Plant Oisease 71:452-455.

FERRIS, H. 1987. Extraction efficiencies and population estimation. Vistas in Nematology Chapter 10.

66.003 CRIS0098095
NEMATODE POPULATION BIOLOGY

FERRIS H; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4636-H Project Type: HATCH
Agency ID: CSRS Period: 01 APR 86 to 30 SEP 91

Objectives: Develop life table parameters for nematodes that are descriptive of age and stage-specific development rates, survivorship, and fecundity. Develop, verify and validate population models of nematodes in agricultural crops.

Approach: Parameter values are determined in microcosm, verified in mesocosm, and validated in the field. Values include stage-specific development times, stage-specific survivorship, stage- and age-specific fecundity, and infectivity. Adaptive mechanisms including diapause, anabiosis, and estivation will be quantitatively evaluated.

Progress: 87/01 to 87/12. Dbjective 1: Studies continue on egg development in Meloidogyne chitwoodi with special emphasis on mechanisms of diapause. Dbjective 2: Field experiments continue with M. chitwoodi as a basis for prediction of damage and nematode population increase and decrease in barley, potatoes and alfalfa. Studies on the effect of rootknot nematode on the physiological efficiency on the photosynthetic process in grape, and the stage-specific feeding demand of the nematodes are now completed and in the analysis stage. The nematode does not alter the rates of physiological processes, but does alter the partitioning of biomass within the plant. Dbjective 3: Verification and validation of population models is based on follow-up experiments with M. chitwoodi on potatoes. Dbjective 4: The development of an expert systems approach for nematode management decisions in potatoes has been initiated.

Publications: 87/01 to 87/12

SCHNEIDER, S.M. and FERRIS, H. 1986. Estimation of stage-specific developmental times and survivorship from stage frequency data. Research on Population Ecology 28:267-280.

FERRIS, H. and WILSDN, L.T. 1987. Concepts and principles of population dynamics. Vistas in Nematology, Chapter 49.

SCHNEIDER, S.M. and FERRIS, H. 1987. Stage-specific population development and fecundity of Paratrichodorus minor. J. Nematol. 19:395-403.

66.004 CRIS0083422
EXTENSION AND DEVELOPMENT OF THE U.C.D. NEMATODE COLLECTION

FERRIS H; NDFFSINGER E M; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4072-H Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 86 to 30 SEP 91

Objectives: To upgrade the University of California, Davis Nematode Collection (UCDNC) and improve its capability to serve as a reference and identification source, as well as a repository.

Approach: The identified specimen reference material will be expanded through clearing the backlog of mounted specimens, processing selected specimens from wet sample collections, and by filling any existing taxonomic gaps in the reference material by soliciting specimens from the scientific community. National and International scholars will be encouraged to use UCDNC as a nematode repository for their voucher and type specimens, and to come to Davis and conduct taxonomic studies with the UCDNC. By the use of computer assisted-systems, improve the retrievability of environmental data associated with specimens in UCDNC and taxonomic data from the UCDNC Taxonomic Index.

Progress: 87/01 to 87/12. The University of California Davis Nematode Collection (UCDNC) has shown steady growth throughout the year. Total number of catalogued specimens in UCDNC increased by 380 specimens (0.5% growth), and now totals 77,810. Single sample accessions numbered 155 samples (2% growth), bringing the total to 8,018, representing 49 US states and 128 countries. Type specimen section increased by 1 genus (0.5% growth), 8 species (1%), and 30 specimens (0.5%), bringing Type totals to: 237 genera, 818 species, 11,655 specimens, representing 17 of the 20 Drders in the Phylum. General slide section increased by 2 genera (0.5% growth), 6 species (0.5%), and 350 specimens (0.5%), bringing the totals to: 369 genera, 2,080 species, and 66,155 specimens in 18 orders. Wet sample section increased by 10 samples (0.2% growth), bringing the totals to 5,860. Dne very rare species was added to UCDNC. Due to some very recent accessions, the backlog has increased 0.5%. Specimen exchange consisted of: 1) deposits in UCDNC by US workers (3 slides) and by international workers (11 slides, 1 wet sample; 2) loans by UCDNC to non-UCD US workers (74 slides), and to international workers (513 slides, 3 wet samples); 3) UCDNC borrowed 13 slides from other collections; 4) UCD workers deposited 5 slides in US collections and 10 in international collections. The Taxonomic Index was increased by 300 original species descriptions (2% growth), bringing the total to 17,866.

Publications: 87/01 to 87/12

CHOD, H.Y., KAYA, H.K., SHEA, P. and NDFFSINGER, E.M. 1987. Ecological Study of Nematode Parasitism in Ips Beetles from California and Idaho. J. Nematol. 19(4):495-502.

66.005 CRIS0094972
NEMATODE DIAGNOSTICS, BIOLOGY AND MANAGEMENT

VIGLIERCHID D R; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4458-H Project Type: HATCH
Agency ID: CSRS Period: 15 JAN 85 to 30 SEP 89

Objectives: To develop a protocol for nematode diagnostic technology, to generate a body of knowledge of basic nematode biology and to devise alternate protocols of nematode pest management reducing dependence upon nematicides.

Approach: Analyze extraction technology as a function of species, soil type and method to upgrade efficiency and quantitative nature. Use laboratory and greenhouse experiments for key biological attributes e.g. life cycle, optimum temperature range, survival to cold temperatures, desiccation, reproductive potential, host ranges, biotypes etc. that are controlling properties in nature. The observations derived from diagnostics and basic biology to devise hypotheses for testing by computer simulation and field trials. Species of nematodes from the following genera will be studied: Meloidogyne, Pratylenchus, Heterodera and Xiphinema.

Progress: 87/01 to 87/12. Since cultivars normally used in relation with potatoes in the Tulelake basin of California, except for alfalfa, are susceptible to Meloidogyne chitwoodi, cultivars grown in relation in other potato growing areas of the world and suitable to gross climate conditions found in Tulelake were tested. Results enabled the selection of resistant cultivars that can now be field tested for practicality. The same approach has been applied to a selection of exotic resistant potato cultivars with the test ongoing. Nematode analysis of turf indicate that over the growing season leaf sheath gall nematodes increase in number from spring to fall, other nematode groups remain constant, while others decrease somewhat. Application of certain nontraditional nematicides reduce different nematode populations, while others effect an increase. It is evident that different modes of action are invoked by different inhibitors and the initial premise stands confirmed, nematode control by means of inhibitors with different modes of action is feasible.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

66.006 CRIS0067477
QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESS

VIGLIERCHIO D R; MAGGENTI A R; ELIOTT A P; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-3345-RRProject Type: HATCH Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Refinement and optimization of sampling and extraction methodology for nematode detection and assessment. Determination of management cost/efficacy functions to allow derivation of economic thresholds.

Approach: Density flotation offers the most promise for quantification and objective routine application. Soil type, nematode species and density flotation are to be tested for evaluating the most effective system within the constraints of efficiency, rapidity and routine application. To assess, in population dynamics as a function of fallow, non-host crops, and nematicide treatments, soil depth, seasonal rainfall and soil temperature to project damage functions. To assess the value of control programs to yearly changes in crop value, pesticide prices and operating costs modifying the values of economic thresholds and farm costs.

Progress: 86/01 to 86/12. Extraction of nematodes from soil is very inefficient and highly variable, e.g., with rootknot larvae in soil, best extraction efficiency is of the order of 50%. Moreover, comparison of extraction efficiency by different laboratories is exceedingly poor varying by a factor of over ten for cysts of Heterodera schachtii. Even detection or non-detection of several nematodes in split samples is in disagreement. Rootknot nematodes appear to be bound to soil and as yet unreleasable by current means. The parameters controlling H. schachtii larvae extraction from soil by sugar flotation are being determined. Is extraction efficiency affected by nematode age, number in soil samples, soil type; what proportion bind to soil, is extraction efficiency a consequence of mass action losses in extraction, can release agents used for soil extraction of other biotic and abiotic agents aid in nematode extraction. Does this binding vary with kind of nematode? These kind of questions are currently under study with the aim of quantifying extraction processes for use in pest management decisions.

Publications: 86/01 to 86/12
NO PUBLICATIONS REPORTED THIS PERIOD.

66.007 CRIS0057179
CHARACTERIZATION OF PLANT PARASITIC NEMATODES FOR IMPROVED SYSTEMATICS AND IDENTIFICATION

BALDWIN J G; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-2593-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: To develop stable taxonomic systems which reflect phylogeny of plant-parasitic nematodes as well as to elucidate functional morphology and develop improved identification of species & pathotypes.

Approach: New characters will be sought through detailed morphological studies using TEM, SEM & light microscopy, and included in phylogenetic analyses employing computer programs. Some characters, such as sensory structures will be studied in detail to access function & establish correlations with biology including behavior. Fine structure & other parameters (e.g., biochemistry) will also be used to diagnose closely related species & pathotypes for improved identification procedures.

Progress: 87/01 to 87/12. I have proposed to develop stable taxonomic systems which reflect phylogeny of plant parasitic nematodes. My approach is to discover new characters, and

elucidate classical characters through the use of transmission (TEM), scanning (SEM) and light microscopy. These characters are entered into a matrix for computer analysis using a variety of algorithms, and competing hypotheses of phylogeny are tested with additional biological parameters. The focus of my work continues to be Heteroderidae. We have completed SEM investigations of lip patterns and identified several features as reliable for phylogenetic analysis while rejecting others due to high variability at the population level. We have nearly completed comparative development of the phasmid at the fine structural (TEM) level. Several new species and a new genus of Heteroderidae has been described, and the cyst has been more clearly defined as a taxonomic character. These characters and new taxa are included in computer generated analyses. Results and a tentative classification are being prepared for publication. We are also investigating physiologic variation of the burrowing nematode (Radopholus similis) and Punctodera chalcoensis. New work is being planned for detailed comparisons of cyst development among heteroderid taxa, and for congruency tests between morphologic and biochemical characters.

Publications: 87/01 to 87/12

LUC, M., WEISCHER, B., STDNE, A.R. and BALDWIN, J.G. 1986. Dn the definition of Heteroderid cysts. Rev. Nematol. 9:418-421.

BALDWIN, J.G. and PDWERS, T.D. 1987. Use of fine structure and nucleic acid analysis in systematics. Chapter 47, Pp. 336-353 in J.A. Veech and D.W. Dickson, eds. Vista, Publications of Society of Nematologists. Lawrence, Kansas.

OTHMAN, A.A., BALDWIN, J.G., MUNDD-DCAMPO, M. 1987. Comparative morphology of Globodera, Cactodera, and Punctodera spp. (Heteroderidae) with scanning electron microscopy. Rev. Nematol. (in press).

BALDWIN, J.G. and SCHDUEST, L.P., JR. 1987. Incorporation of fine structural data in computer assisted phylogenetic analysis of Heteroderidae. J. Nematol. 19:511. Abstr.

CARTA, L.K. and BALDWIN, J.G. 1987. Fine structure of phasmid development in males of Meloidodera floridensis. J. Nematol. 19:517. Abstr.

MUNDD-DCAMPD, M. and BALDWIN, J.G. 1987. Physiological homogenity of the burrowing nematode in Mexico. J. Nematol. 19:545. Abstr.

MUNDD-OCAMPD, M., BALDWIN, J.G. and JERDNIMD-R., J. 1987. Distribution and host range of Punctodera chalcoensis. J. Nematol. 19:545-546. Abstr.

66.008* CRIS0014679

NEMATODE PATHOBIOLOGY AND BIOLOGICAL CONTROL OF PLANT-PARASITIC NEMATODES

MANKAU R; VAN GUNDY S D; Nematology; University of California, Riverside, **CALIFORNIA** 92521.

Proj. No.: CA-R*-NEM-1718-H Project Type: HATCH Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Collect, catalog, & study organisms attacking nematodes; determine factors which influence activity, survival, & interaction with nematodes; develop techniques & practices which permit utilization of promising antagonists in agricultural production; examine effects of pesticides on natural enemies, nematode population dynamics, & the role of nematodes in the general microbial ecology of soil.

Approach: Isolated biocontrol agents will be studied by appropriate techniques, assayed for effectiveness & suitability in field application, & for persistence. Antagonists specific to major pests will receive most attention. The effects of pesticides, cultural practices, & amendments on biological control will be studied by monitoring nematode populations in fields where these practices are used & experimentally.

Progress: 87/01 to 87/12. Taxonomic studies of nematophagous fungi in the genera Arthrobotrys, Dactylella, Dactylaria and Monacrosporium are proceeding with a view toward revision of these genera and the preparation of monographs and keys of Arthrobotrys and Monacrosporium. More than 500 isolates have been collected, catalogued and studied. Pasteuria penetrans was cultured in vitro in M. javanica and M. incognita within A. rhizogenes transformed roots (TR) on modified M-S medium. Transformed tomato, potato and Convolvulus sepium all supported Meloidogyne populations and those infected with P. penetrans could be cycled through subcultures on TR and produced infective spores providing an excellent opportunity for sterile culture and study of the parasite. The abundant and highly varied flora of predacious fungi associated with citrus nematode-infested orchards have complex relationships with the citrus rhizosphere and rhizoplane and with the nematode population. On agar they exhibit a variety of growth responses and behavior which are influenced by specific C/N ratios, pH and other factors. Most of these fungi trap and consume citrus nematode larvae very effectively in vitro but in nature they may play an incidental cumulative antagonist role which results in the equilibration of the nematode population by subtle uncontrollable interactions. Dver 5,000 bacterial isolates were screened for antagonism to root knot nematodes, fusarium wilt, and for plant growth enhancement.

Publications: 87/01 to 87/12

GASPARD, J.T. and MANKAU, R. 1987. Density-dependence and host-specificity of the nematode-trapping fungus Monacrosporium ellipsosporium. Revue Nematol. 10:241-246.

GASPARD, J.T. and MANKAU, R. 1987. Nematophagous fungi associated with Tylenchulus semipenetrans and the citrus rhizosphere. Nematologica 33:359-364.

MANKAU, R. and BARTNICKI, E.W. 1987. Studies on the biology of nematode-trapping fungi associated with the citrus nematode, Tylenchulus semipenetrans. J. Nematol. 19:540.

VERDEJO, S., JAFFEE, B.A. and MANKAU, R. 1987. The use of Agrobacterium rhizogenes transformed root cultures for the reproduction of Meloidogyne javanica and Pasteuria penetrans. J. Nematol. 19:560.

66.009 CRIS0072864
ECOLOGY OF NEMATODES IN AGRICULTURAL AND NONAGRICULTURAL SOILS

VAN GUNDY S D; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-3558 Project Type: STATE
Agency ID: SAES Period: 01 JUL 85 to 30 SEP 91

Objectives: To study the interrelationships and survival of nematode trophic groups in soil and their interactions with environmental factors, plant roots, root rhizosphere, soil microflora and soil fauna to gain an understanding of the soil ecosystems.

Approach: Examine nematode community structure in natural and agricultural soils both in the field and in the greenhouse. Focus will be on the root rhizosphere-plant root-soil biota system of both perennial and annual plant systems. Studies will also include interactions with microarthropods, mycorrhize, rhizobia and insect herbivores. Research will be carried out at University of California, Riverside, New Mexico State University, and Texas Tech University.

Progress: 87/01 to 87/12. A deep rooting symbiotic plant (mesquite, Prosopis glandulosa) occurs at four different ecosystems on the NSF Jornada LTER site near Las Cruces, NM. Effects of nematodes & soil micro-arthropods on symbiont function were examined at depth. Nematodes of all tropic groups occurred at 12 and 13m, including Xiphinema sp. The nematode community was highly correlated with TKN, NO3 and Pi. However, the trophic groups responded differently to soil properties, i.e., fungivores were more highly correlated with Pi. Initial results indicate deep root systems have biotic activity similar to surface soils. A field experiment in which 600 sterile, 2m-long soil tubes were placed into the desert to measure root and rhizophere development over time, is being analyzed. A model of the nematode bacterivore, (Acrobeloides sp.) was used to examine activity patterns of free-living nematodes in deserts. Eggs & larvae develop quickly at warm temperatures (Lab results) providing a high potential growth rate for the population when moisture is not limiting. Predicted activity patterns were consistent with field observations of nematode-related decomposition processes. Studies on C allocation, using C, in two ecotypes of the Serengeti Panicum grass, as affected by grasshoppers, nematodes and VAM, are being conducted at Duke Univ. Carbon transport speed is slower to nematode infected roots, but the C export pool in nematode infected roots is greater than control plants.

Publications: 87/01 to 87/12

MOORHEAD, D.L., FRECKMAN, D.W., REYNOLDS, J.F. and WHITFORD, W.G. 1987. A Simulation Model of Soil Nematode Population Dynamics: Effects of Moisture and Temperature. Pedobiologia 30:361-372.
VAN GUNDY, S.D. 1987. Perspectives on Nematology Research. In: J.A. Veech and D.W. Dickson (eds.). VISTAS on Nematology. Chapter 5. Society of Nematologists, Inc. Pp. 28-31.

66.010* CRIS0057795
DETECTION, BIOLOGY & CONTROL OF NEMATODES INCITING DISEASES OF AVOCADO, CITRUS, ORNAMENTALS & TURF

VAN GUNDY S D; RADEWALD J D; BALDWIN J G; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-2708 Project Type: STATE
Agency ID: SAES Period: 01 JUN 84 to 30 SEP 89

Objectives: To detect and to determine pathogenicity and biology of various nematodes associated with ornamentals, turf, citrus and avocado. To seek means of control of pathogenic nematodes on these crops through the most efficient usage of new and established nematicides or cultural practices. To evaluate potential varieties or rootstocks for nematode resistance. To provide research on CDFA quarantine and nursery registration programs.

Approach: Survey problem areas of ornamentals, turf, citrus and avocado and determine if nematode pests are involved. If nematodes are suspect as a causal agent of the disease, determine if they are pathogenic and develop economical and reliable means of control through biological cultural means, resistant varieties, or chemicals. Target pests will be studied in isolated quarantine facilities.

Progress: 87/01 to 87/12. Postplant studies conducted with drip irrigation systems for citrus nematode demonstrated two materials, Nemacur and CY81 provided an economic level of control. Additionally, GY81 provided a degree of control of Phytophthora that warrants further investigation. A label change for Nemacur, lessening the time between treatment and harvest (30 days instead of 180 days) along with Nemacur's performance, in all likelihood will make this product a strong candidate for grower useage. Work on morphologic variation and taxonomy of Punctodera in Mexico, Canada, and the U.S. has included investigation of populations apparently pathogeneic on golf greens in the San Francisco area. In addition, we continue investigation of physiologic variation of Radopholus species, including serious pests of citrus and many ornamentals. Recent studies indicate physiologic homogeneity of this nematode in Mexico and confirm that populations in Mexico are not a pathogens to citrus. Ecology studies on the citrus nematode suggest that larvae and males are not active at all times in irrigated groves. The citrus nematode has weak anhydrobiotic survival strategies when confronted with water stress. Studies on parasitism and carbohydrate partitioning are continuing as are studies for

resistance to the citrus nematode in new citrus crosses with citrus relatives. An artificial feeding system is being developed for Hemicycliophora arenaria.

Publications: 87/01 to 87/12
MUNDO-OCAMPO, M. and BALDWIN, J.G. Physiological homogeneity of the burrowing nematode in Mexico. J. Nematol. 19:545. Abstr.

66.011* CRIS0095237
HOST-INDEPENDENT ENDOSPORE PRODUCTION FROM A BACTERIAL PATHOGEN OF ROOT-KNOT NEMATODES

PREVIC E P; Microbiology & Cell Science; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-MCS-02488 Project Type: STATE
Agency ID: SAES Period: 21 MAR 85 to 30 SEP 90

Objectives: Develop procedures for growing BSPN (bacterial spore parasite of nematodes), independent of nematode hosts, with goal of large scale production of BSPN spores. Study molecular interactions of BSPN spore surface components with receptors on cuticle surface of nematode hosts.

Approach: Grow BSPN in Meloidogyne species of root-knot nematodes on tomato plants by standard methods. Harvest female nematodes to collect BSPN spores, and at intermediate stages to isolate vegetative form of BSPN. Subject BSPN spores (and any recovered vegetative cells) to diverse conditions which are known to favor activation and outgrowth of spores of endospore-forming procaryotic microorganisms. Subject BSPN spores to activation with fractions of nematode cuticles and root exudates. Monitor activation and outgrowth of BSPN by optical density, electron microscopy, photometric immersion refractrometry and chemical changes in cortex peptidoglycan and other components. Remove BSPN spore coats and exosporia by di-sulfide bond-breaking reagents and/or enzymes. Test capacity of altered spores to bind to nematode hosts.

Progress: 87/10 to 88/09. Pasteuria penetrans and Pasteuria thornei were grown in their respective host nematodes, Meliodogyne incognita and Pratylenchus brachyurus, both on excised root cultures (tomato and corn), and in explanted tissues on tissue culture media. Endospores were produced in each situation. Studies are continuing on these and other Pasteuria in attempts to transfer their vegetative growth phase from their natural host nematodes to "non-host" nematode tissues. In part, this approach is designed to show if the natural host is required only for the germination of spores of its specific Pasteuria parasite, or if the specificity resides also in the composition of the host tissues and/or pseudocoelomic fluid.

Publications: 87/10 to 88/09
NO PUBLICATIONS REPORTED THIS PERIOD.

66.012 CRIS0099776
GENETIC VARIATION IN MITOCHONDRIAL DNA'S AMONG GEOGRAPHIC POPULATIONS OF ROTYLENCHULUS RENIFORMIS

CASWELL E P; GERMAN T L; Plant Pathology; University of Hawaii, Honolulu, **HAWAII** 96822.
Proj. No.: HAW00768-G
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 JUL 86 to 30 JUN 89

Objectives: Determine the genetic variability as measured by mtDNA polymorphism of Rotylenchulus reniformis from fields in Hawaii. Correlate mtDNA polymorphism with phenotypic variability by determining if the genetic variability identified among isolates is associated with differential host ranges and identify plant that have some level of resistance to subpopulations of R. reniformis. Determine the virulence of subpopulations of R. reniformis on putatively resistant plant species.

Approach: Populations of Rotylenchulus reniformis will be collected from different locations in the Hawaiian Islands, and each population will be reared on a series of host plants to differentially increase different phenotypes. The different phenotypes will be analyzed for mtDNA polymorphism using restriction enzyme digestion, and then compared for their ability to parasitize host plants that carry different genes for resistance.

Progress: 86/10 to 87/09. Collections of the reniform nematode (Rotylenchulus reniformis) from Oahu, Maui and Lanai have been made. Cultures are being maintained in the greenhouse. Due to an inconsistent ability to isolate mtDNA from cultures, progress has been extremely slow. An attempt was made to clone the mtDNA of Radopholus similis (as a model) into the plasmid vector pBR322. This attempt was made to try and find an easier way to collect significant nematode biomass for mtDNA extraction; a problem with the reniform nematode. The initial attempt was gauged to be successful; however, the mtDNA was not maintained in the plasmid.

Publications: 86/10 to 87/09
NO PUBLICATIONS REPORTED THIS PERIOD.

66.013* CRIS0049456
INTERRELATIONSHIPS OF PLANT-PARASITIC NEMATODES AND THEIR NATURAL ENEMIES

SAYRE R M; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-024-00D
Project Type: INHOUSE
Agency ID: ARS Period: 15 APR 85 to 15 APR 90

Objectives: To isolate, catalog, and study soil microorganisms which aggressively attack plant-parasitic nematodes and to determine the edaphic factors influencing their survival and beneficial activities. In particular, to investigate separately and in combination the interactions of antagonists with pest nematode

populations and develop techniques and practices which permit their utilization as biocontrol agents (natural nematicides) in agricultural production systems.

Approach: Biocontrol agents isolated by appropriate sampling and laboratory techniques will be assayed for their nematicidal effectiveness and suitability for field applications. Their behavior or interrelationships (e.g. attrac-tion, penetration, and colonization of host nematodes) will be observed, recorded and analyzed. The role of environmental stress factors on nema- tode susceptibility to parasitism and on the mechanism governing the antagonist-nematode interactions will be investigated.

Progress: 87/01 to 87/12. Some species of soil fungi and bacteria that are natural enemies of plant-parasitic nematodes have been isolated and evaluated for their efficacy as potential biological control agents. The more promising agents were retained for developmental studies or for further biocontrol research. Strains that act as biocontrol agents in laboratory studies may eventually be used by growers to suppress nematode populations. A bioassay technique was developed for testing the potential of fungi to act as biocontrol agents of soybean cyst nematode. Stains were evaluated to determine which reliably distinguished eggs that had been killed by fungi from viable nematode eggs, and one of these stains was then used in the bioassay. Three fungi caused a statistically measureable decrease in the percentage of live eggs, and other fungi affected eggs to a lesser extent. Ten fungi exhibiting biocontrol potential were inoculated onto agar containing benomyl to determine the level of tolerance each fungus has to this fungicide. Cultivation of Pasteuria penetrans, a bacterium and a possible biocontrol agent of plant nematodes, was pursued through nutritional studies. A few of the experimental media appear to support modest growth of some of the bacterial isolates.. Electronmicroscopy studies of the fine structure of a Pasteuria species isolated from Heterodera glycines revealed a group of characteristics that distinguish this bacterium from others in its group.

Publications: 87/01 to 87/12

KRECEK, R.C., SAYRE, R.M., ELS, H.J., VAN NIERKIRK, J.P.and MALAN, F.S. 1987. Fine structure of a bacterial community associated with Cyanthostomes of zebras. J. Nematol. 19(4):537. (Abstract).

KRECEK, R.C., SAYRE, R.M., ELS, H.J., VAN NIERKIRK, J.P. and MALAN, F.S. 1987. Fine structure of a bacterial community associated with Cyanthostomes (Nematoda: Strongylidae) of zebras. Proc. Helmintho. Soc. Wash. 54(2):212-219.

MEYER, S.L.F. and SAYRE, R.M. 1987. Isolation and evaluation of selected fungal species potentially pathogenic on soybean cyst nematodes. J. Nematol. 19(4):543-544. (Abstract).

REISE, R.W., HUETTEL, R.N. and SAYRE, R.M. 1987. Use of carrot callus tissue in culturing endoparasitic nematodes. J. Nematol. 19(3):387-389.

SAYRE, R.M. and GOLDEN, A.M. 1987. Morphological differences of endospore among members of the Pasteuria penetrans group parasitizing nematodes. J. Nematol. 19(4):555. (Abstract).

SAYRE, R.M., WERGIN, W.P., ENDO, B.Y., and STARR, M.P. 1987. Ultrastrcture comparison of Pasteuria penetrans a bacterial parasite of Meloidogyne incognita and a related parasite of Pratylenchus brachyurus. J. Nematol. 19(4):555-556. Abst.

66.014* CRIS0092111

INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

BIRD G W; Entomology; Michigan State University, East Lansing, **MICHIGAN** 48824.
Proj. No.: MICL01460 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 88

Objectives: To determine the influence of abiotic factors on the occurrence and severity of pine wilt disease in conifer.

Approach: Accurate biological monitoring procedures for the detectionof Bursaphelenchus(underlined) xylophilus(underlined) and the pine wilt disease will be developed for use in Michiganforests. The nature and distribution of the pathogen and disease will be evaluated in relation to environmental monitoring data. The resources of the Michigan CooperativeForest Pest Management Program will be used for implementation of the research.

Progress: 87/01 to 87/12. The Michigan State University pinewood nematode research program continues to operate on a very limited basis. Studies on the potential of morantel tartrate for control of Bursaphelenchus xylophilus have been inconclusive. The research will be continued in 1988 and 1989. In 1987, mortality of pine trees due to the pinewilt disease and the pinewood nematode increased significantly. In urban environments, demonstration of optimal water and nutrient levels for trees in high risk sites appear to be providing protection against the pinewilt disease. In 1987, Bursaphelenchus xylophilus was recovered from Jack Pine in Michigan in a forest environment.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

66.015* CRIS0083300

INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

CHEN T A; MYERS R F; Plant Pathology; Rutgers University, New Brunswick, **NEW JERSEY** 08903.
Proj. No.: NJ11282 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Develop improved nematode sampling methodology and assay procedures for IPM programs; determine the relationships among initial nematode population densities and crop

yields, and the impact of biotic and abiotic stresses on these relationships; develop and validate predictive crop assessment systems; using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Sampling precision will be tested in field and microplots on several genera of plant parasitic nematodes. Microplots will be established using different soil types and similar nematodes and crops. Electron microscopy, histopathology and nematode culturing procedures will be used to study nematode-virus interactions. Economic thresholds will be modeled by computer to predict yield losses from stress factors and edaphic factors.

Progress: 87/01 to 87/12. Tomato ringspot virus (TomRSV) is transmitted in nature to apples and peaches by the dagger nematode Xiphinema sp. In 1987, we have made the following studies: Development of an improved method to purify Tom RSV: Using a modified buffer and density gradient centrifugation three distinct bands were visible and they were collected in a fractionator equipped with a densitometer scanned at 254 nm. 0.79- 0.97 mg of Tom RSV could be obtained from 100 g of diseased plant tissues.Monoclonal antibodies specific against Tom RSV: Monoclonal antibodies to TomRSV have been developed from hybridoma techniques. Spleenic cells obtained from immunized BALB/c mice were fused with murine myeloma cells (NS-1). Specific antibodies produced from hybridomas were screened against TomRSV. Tom RSV-infected plants and healthy uninfected plants using ELISA. Detection of double stranded RNA from Tom RSV-infected plants: Double-stranded RNA was eluted from 10 cm CF-11 cellulose column in STE buffer (0.1 M NaCC, 0.05 M Tris, 0.001 m EDTA, pH 7.0) only from infected squash plants but not from healthy plants. Electrophoresis in polyacrylamide and agarose gels showed three dsRNA species all of which were resistant to treatments with DNAse and RNAse A.

Publications: 87/01 to 87/12

MOHAN, S. and CHEN, T.A. 1987. An improved procedure for the purification of tomato ringspot virus. N.J. Acad. of Science Bulletin 31:12.

MOHAN, S. and CHEN, T.A. 1987. Detection of double-stranded RNA from squash infected with tomato ringspot virus (TomRSV). Phytopathology 77 (In press).

MOHAN, S. and CHEN, T.A. 1987. Absence of 3'polyadenylation in the RNA of a tomato ringspot virus (TomRSV) isolate. Phytopathology 77 (In press).

66.016* CRIS0136382

RESISTANCE MECHANISMS IN SOYBEAN-HETERODERA GLYCINES INTERACTIONS

HUANG J S; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC09353 Project Type: CRGO
Agency ID: CRGO Period: 01 JUL 88 to 30 JUN 90

Objectives: PROJ. 8800786. The objectives of this research are i) to determine the spatial and temporal accumulation of glyceollin I at the sites of nematode infection; and ii) to determine the effects of glyceollin I on physiology and reproduction of H. glycines at the concentrations detected in infected roots.

Approach: Radioimmunoassay and cryostate microtomy will be used to determine levels of glyceollin I accumulated at the sites of nematode infection in various compatible and incompatible soybean cultivar-nematode race combinations. Effects of glyceollin I on respiration, motility, and reproduction on soybean will be investigated.

66.017* CRIS0131463

GENETIC TRANSFORMATION OF A SOIL NEMATODE BY MICROINJECTION OF CLONED DNA

MILLER D M; Zoology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC05644 Project Type: STATE
Agency ID: SAES Period: 01 OCT 86 to 30 APR 88

Objectives: The objective of this proposal is to develop a reliable method for inserting genes into the chromosomes of a soil nematode. We intend to employ this technique to identify DNA sequences that regulate the expression of nematode genes. The information to be gained from this project is fundamentally important to our understanding of the genetic specification of nematode development.

Approach: Cloned genes will be microinjected into oocyte nuclei in the gonad of a mature nematode. The host embryo is genetically disabled in such a way that it cannot reproduce unless the injected DNA is incorporated into its genome. Thus, when fertile offspring arise from the injected parent then the exogenous DNA has been successfully inserted into the genome. In this way, nematode genes that have been chemically modified in the laboratory can be assayed for the effects of these changes in vivo.

Progress: 86/10 to 87/12. The principal objective of this project has been to develop an efficient microinjection method for genetic transformation experiments with the nematode, C. elegans. A Nikon inverted microscope was equipped with epifluorescence and Nomarski DIC optics. The Nikon microscope stage was adapted to accommodate a Zeiss motorized micromanipulator. We now have a sophisticated microinjection set up that will be used in several new projects in the laboratory that are designed to clone genes regulating the development and function of the nematode nervous system.

Publications: 86/10 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

66.018* CRIS0131464
MOLECULAR GENETIC ANALYSIS OF A MYOSIN HEAVY CHAIN GENE EXPRESSION

MILLER D M; Zoology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC05645 Project Type: STATE
Agency ID: SAES Period: 01 OCT 86 to 30 JUN 88

Objectives: The objective of this project is to dissect the genetic mechanisms regulating the expression of myosin heavy chain (MHC), a major protein component of muscle. DNA sequences adjacent to a nematode MHC will be analyzed to search for putative regulatory or promoter sites. Mutations that alter these regions and which affect MHC gene expression will be sequenced in order to identify the specific regulatory domains.

Approach: We have designed a genetic scheme that selects for mutants expressing elevated levels of MHC in the nematode. With this approach, we hope to isolate mutations in DNA sequences that regulate MHC expression. The specific lesions associated with each mutant will be determined by DNA sequencing methods.

Progress: 87/01 to 87/12. We have initiated a molecular genetic analysis of the regulation of myosin heavy chain (MHC) gene expression in the nematode, C. elegans. There are four separate MHC genes (A,B,C,D) that are differentially expressed in nematode muscle. We have employed a genetic selection scheme that is specifically designed to isolate mutations that elevate the expression of the MHC A gene. The rationale is to identify cis-acting DNA sequences as well as trans-acting loci that specifically regulate MHC A expression. We have used a blot-hybridization technique to determine that the MHC A gene is amplified in eleven out of 13 mutants that we have analyzed. Therefore, in these cases, enhanced MHC A expression is a direct result of transcription from 2 or more copies of the MHC A gene. In the other two mutants, m292 and m168, MHC A gene copy number is not increased. These mutants will be genetically mapped. If either is closely linked to the MHC A gene (cis- acting) we should be able to determine the DNA sequence of the lesion since the MHC A gene is already cloned. Potential trans- acting loci should be clonable once they are placed on the genetic map given the availability of a recently constructed restriction map of the entire C. elegans genome. We are encouraged by these results and intend to isolate additional mutations that affect MHC A gene expression in our continuing effort to understand the mechanisms regulating muscle gene expression.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

66.019 CRIS0135064
MOLECULAR GENETICS OF NEURAL SPECIFICITY

MILLER D M; Zoology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC05678 Project Type: STATE
Agency ID: SAES Period: 01 MAY 88 to 30 SEP 93

Objectives: The objective of this proposal is to understand the molecular basis of neural specificity in the soil nematode, C. elegans. Mutations in the unc-4 gene result in an abnormal pattern of neuronal input to one class of motor neurons in the nematode nervous system. We intend to clone the unc-4 gene and to determine its DNA sequence. With the information gained from this approach, it should be possible to formulate a model to explain the mechanism of unc-4 action. The outcome of this project is fundamentally important to our understanding of the genetic specification of nematode development.

Approach: The method of transposon tagging will be employed to isolate the unc-4 gene. We have obtained a spontaneous unc-4 mutant from a nematode strain exhibiting high transposition frequencies and identified novel transposon insertions adjacent to the unc-4 locus. We will clone transposon-bearing DNA restriction fragments into a plasmid vector in order to isolate the unc-4 gene. The unc-4 gene will be sequenced and the protein coding region mapped. We will prepare antibodies to the predicted protein sequence and localize the native unc-4 gene product in developing nematodes by immunocytochemical labeling techniques.

66.020* CRIS0088731
INCIDENCE, BIOLOGY, AND MANAGEMENT OF THE PINE WILT COMPLEX

BERGDAHL D R; Forestry; University of Vermont, Burlington, **VERMONT** 05405.
Proj. No.: VTZ00046
Project Type: MCINTIRE-STENNIS
Agency ID: CSRS Period: 01 OCT 83 to 30 SEP 89

Objectives: To determine the mechanism of pine wilt diseases and of resistance, within and among species of conifers.

Approach: Laboratory and field methods will be required to study the biology of (Bursaphelenchus(underlined) xylophilus(underlined)) and other organisms associated with pine wilt disease. These methods will include: survey, vector identification, stem analysis, histology, and host predisposition.

Progress: 86/10 to 87/09. Bursaphelenchus xylophilus (pine wood nematode=PWN) has been used to inoculate large trees in the field but to date tree mortality has not resulted. During 1987 (June-September) 140 trees were inoculated at weekly intervals and approximately 60,000 nematodes were inoculated per tree. Chipwood studies continue in an attempt to better understand the population dynamics of the PWN

in that wood product. Variability in nematode numbers presents sampling problems. Nematode populations tend to peak at about 3-5 weeks (incubation) and then decline. Various fungi appear to be an important food source. Weevils are being investigated as potential vectors of the PWN in association with wood chips. Fungicicide efficacy and phytotoxicity studies with chlorothalonil and benodanil on balsam fir and blue spruce, respectively, continue at Jericho and Wolcott Research Forests. Frost damage assessment on balsam fir continues following a late spring frost (6/3/86). Two graduate students and 3 work study students were supported between October 1986 and September 1987. The government of Finland is fully supporting one of their graduate students to work on the PWN project at the University of Vermont.

Publications: 86/10 to 87/09

HALIK, S. and BERGDAHL, D.R. Infestation of wounded roots of Pinus strobus by Bursaphelenchus xylophilus from contaminated wood chips mixed in soil. Phytopathology (in press). Accepted for publication 9/15/87.

BERGDAHL, D.R. 1987. Understanding the effects and ecology of fire. Pp. 25-27 in Proceedings Prescribed Fire in New England.

BERGDAHL, D.R. 1987. Impact of Pine Wood Nematode in North America: Present and Future. Journal of Nematology (in press). Accepted for publication 8/10/87.

66.021 CRIS0099698

VARIABILITY AND INTERACTIONS OF ROOT-KNOT AND CYST NEMATODES

EISENBACK J D; Plant Pathology Physiology & Weed Science; Virginia Poly Inst, Blacksburg, **VIRGINIA** 24061.

Proj. No.: VA-135116 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 86 to 30 SEP 91

Objectives: Determine the distribution of species and races of Meloidogyne, Heterodera, and Globodera in Virginia. Assess the effect of nematode interactions on the expression of cultivar resistance to nematode species. Determine the morphological and physiological variation of several cytological populations of Meloidogyne hapla.

Approach: Identification of species and host races of root-knot and soybean cyst nematodes from throughout the state. Split-root technique to determine the effect of infection by the species on the resistance in a plant cultivar to another species. Morphological evaluation of several cytological forms of the northern root-knot nematode M. hapla.

Progress: 87/01 to 88/09. Additional morphological studies of root-knot nematodes have revealed several new and useful characters for species identification. These characters include female body shape, morphology of the stylet of females; body, tail, and head shape of second-stage juveniles; and head and stylet morphology of males. Examinations of MELOIDOGYNE species that are uncommon have increased information about the morphological diversity of the genus and have indicated that several species that are currently included in the groups probably require placement into other described genera or new genera. Identification of currently recognized genera in MELOIDOGYNE, with 70 species, NACOBBODERA, MELOINEMA, and BURSADERA, each monotypic. The diagnosis of each genus is adequate and they can be identified under a dissection microscope as two promophs P-melo (MELOIDOGYNE) and p-nacobbod (NACOBBODERA, MELOINEMA, BURSADERA). Several nests of species can be described in MELOIDOGYNE on the basis of characters seen in the light microscope.

Publications: 87/01 to 88/09

RAMMAH, A., 1987, Evaluation of the utility of a stylet extraction technique for understanding morphological diversity of several genera of plant parasitic nematodes., Journal of Nematology 19:116-122.

EISENBACK, J.D., 1988, Additional notes on the morphology of Meloidogyne kikuyensis., Journal of Nematology 20:xxxx (abstract)

EISENBACK, J.D., 1988, Identification of Meloidogynids., Proc. NATO Advanced Workshop, Raleigh, NC, abstract

EISENBACK, J.D., 1988, Reproduction of the northern root-knot nematode, Meloidogyne hapla on three species of marigolds., Virginia Academy of Science 39-94 (abstract)

66.022 CRIS0097085

PHYSIOLOGICAL STUDIES OF INSECT PATHOGENIC BACTERIA IN THE GENUS XENORHABDUS

NEALSON K; USDA-ARS Southern Field Crop Insect Management Lab; University of Wisconsin, Milwaukee, **WISCONSIN** 53201.

Proj. No.: WISR-8500613 Project Type: CRGO
Agency ID: CRGO Period: 01 SEP 85 to 31 AUG 87

Objectives: Proj 8500613. Nematodes in the group Heterorhabditis bacteriophora are pathogenic against a variety of insects, many of which are common agricultural pests. The pathogenicity is due to the presence of symbiotic bacteria in the genus Xenorhabdus that reside in the guts of the nematodes. However, little is known about the physiology and toxicology of Xenorhabdus and its specific role in killing insects. The research proposed here will determine the factors responsible for growth regulation and synthesis of key cellular components when the bacteria are grown in host-free systems. Specifically, we will focus on the following aspects: Conversion between primary and secondary forms, rate, regulation and extent of bacterial growth, production and regulation of bioluminescence, and production of intracellular crystalline inclusions.

Approach: Our approach will involve standard techniques of bacterial physiology and biochemistry, along with continuous culture techniques. This will allow us to control bacterial growth while measuring and comparing the other parameters of interest.

Progress: 85/08 to 87/08. During the two year tenure of this grant, the following accomplishments were made: 1) A defined medium for the growth and maintenance of several strains of Xenorhabdus luminescens was developed; 2) the pigment produced by X. luminescens, strain Hm, was purified and identified as a pH sensitive anthraquinone, a compound previously unknown in bacteria; 3) the antibiotic produced by strain Hm was identified as a hydroxystilbene compound; 4) the regulation of luminescence in several strains was studied, and found to be very different from that observed in other luminous bacteria. In particular, a) the phenomenon of autoinduction did not occur in any of these strains, and b) under iron limiting conditions, there was no enhancement of bioluminescence, and excess iron does not inhibit luminescence; 5) the characteristics of primary and secondary forms of X. luminescens were studied under a variety of different conditions; 6) the luciferase of strain Hm was purified to homogeneity, and its properties studied in vitro. It is quite similar to luciferases from the marine luminous bacteria; 7) a protease thought to be involved with the insect pathogenicity of strain Hm was purified to homogeneity and characterized in vitro; 8) the genes for bioluminescence (lux genes) were isolated from Xenorhabdus luminescens (Hm), cloned into a pUC plasmid, and expressed in E. coli. These bright E. coli cells are now under study in order to determine the genetic organization of the lux system.

Publications: 85/08 to 87/08
NO PUBLICATIONS REPORTED THIS PERIOD.

67.001 CRIS0049197
RESEARCH TO SUPPORT REGISTRATION OF MINOR USE PESTICIDES

SCHWARTZ P H; Poultry Meat Quality & Safety Research Unit; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 0500-21010-007-12D
Project Type: INHDUSE
Agency ID: ARS Period: 04 JUN 84 to 04 JUN 89

Objectives: To provide national leadership in coordination of the minor use pesticide program in ARS. To review, evaluate, and coordinate the development of efficacy, phototoxicity, and residue data for about 400 food and 2,000 ornamental minor use pesticide needs in ARS.

Approach: Minor use pesticide needs will be reviewed, evaluated, and coordinated thrua series of 4 state regional meetings, an ARS liaison representtive meet- ing, and a national research planning meeting. Scientists to conduct the research in ARS will be identified and funds and projects will be recom- mended to the Administrator's office by the Minor Use Pesticide Advisory Group. Research protocols will be developed and research progress and results reviewed by the national coordinator of the minor use pesticide program.

Progress: 87/01 to 87/12. Coordinated 156 food and 306 ornamental minor use pesticide research projects with 25 ARS scientists. Data to support the registration of minor use pesticides for approximately 189 projects were sent to IR-4 Headquarters. These data were used in partial support of 65 tolerances on food crops and 306 registrations on ornamentals. These tolerances and registrations will allow growers to utilize these pesticide uses safely and effectively to maintain the quality of their crops and help increase their economic returns.

Publications: 87/01 to 87/12
NO PUBLICATIDNS REPDRTED THIS PERIDD.

67.002* CRIS0091873
PERIDERM ONTOGENY IN NORMAL AND NEMATODE-INFECTED ROOTS OF COTTON

DUTE R R; Botany Plant Pathology & Microbiology; Auburn University, Auburn, **ALABAMA** 36830.
Proj. No.: ALA00616 Project Type: HATCH
Agency ID: CSRS Period: 21 DCT 83 to 30 SEP 88

Objectives: Initiate a detailed light and ultrastructural study of periderm initiation and growth in uninfected cotton roots. evaluate wound periderm formation in nematode-infected roots and its relationship to Fusarium(underlined) susceptibility.

Approach: Healthy tap roots from cotton seedlings grown under controlled conditionswill be processed both for light microscopy and transmission election microscopy. Study will be concentrated on the initiation and development of the periderm, a tissue which affects both water uptake and disease resistance. Nematode-infected cotton roots typically show tissue splitting at the sites of nematode infection and development. These splits may provide a pathway of infection for secondary pathogens such as the Fusarium(underlined) wilt organisms. In order to determine whether such wounds are isolated from the rest of the root by a wounded-induced periderm, cotton roots of varieties with different Fusarium(underlined) resistance will be grown under controlled conditions; infected with the nematode Meloidogyne(underlined) incognita(underlined);and processed as above.

Progress: 87/01 to 87/12. Recent work has centered on the changes in cotton roots as they age. In young roots the endodermis contains tanniferous compounds having antipathogenic properties. Electron micrographs show the material in question to be deposited as electron-dense bodies within vacuole adjacent to the vacuolar membrane. During early stages of deposition, tannins may be associated with numerous membrane profiles. When surrounded by the tannins, the membranes stand-out in negative relief. Appearance and development of tannins are similar to deposits in the developing seedcoat of soybean. With continued root development, outer cell layers of the cotton root are replaced by the periderm. During this process, inner periderm cells and root stele cell within the periderm develop contents of similar appearance to those of the endodermis. It is hypothesized that not only does the periderm form a physical barrier to pathogen entry by its suberized surface but also provides the proper environment for the development of chemical defenses. In work of a related nature dealing with root ontogeny, studies were initiated on the weed Diodia virginiana under the leadership of Dr. R. Dickens. As in cotton roots, buttonweed roots form a periderm which replaces the epidermis as the dermal tissue. The meristem of the periderm assists in formation of a starch storage parechyma, which in turn forms adventitious buds, an effective means of vegetative reproduction.

Publications: 87/01 to 87/12
DUTE, R.R., BAIRD, J.H., RUSHING, A.E. and DICKENS, R. 1987. The anatomy of vegetative reproduction of Virginia buttonweed. Agronomy Abstracts, p. 134.
RUSHING, A.E., DUTE, R.R., BAIRD, J.H., GUDAUSKAS, R.T. and DICKENS, R. 1987. Ultrastructural aspects of a virus-like disease in Virginia buttonweed. Agronomy Abstracts, p. 138.

67.003* CRIS0085861
PHYTOPARASITIC NEMATODES: DAMAGE THRESHOLDS, DISTRIBUTION AND IDENTIFICATION ON IMPORTANT CROPS

RDBBINS R T; Plant Pathology; University of Arkansas, Fayetteville, **ARKANSAS** 72701.
Proj. No.: ARK01096 Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 87 to 30 SEP 92

Objectives: Determine damage thresholds for soybean cyst nematode and other phytoparasitic nematodes on crops in Arkansas. Develop a modeling system to predict nematode damage. Determine effects of crop rotation, fumigation and crop resistance on population dynamics of phytoparasitic nematodes. Conduct nematode surveys on soybean, wheat and cotton. Provide basic information on nematode species, thresholds, distribution, and identity needed to make timely advisories to growers.

Approach: Microplots, fumigation of field plots, and crop rotations will be used to establish and define damage threshold data. In microplots the effects of selected variables will be investigated. Nematodes will be identified to species. Species, host and location will be recorded for host and distribution records. Experiments will be designed for statistical analysis.

Progress: 87/01 to 87/12. During 1987 personnel in the Arkansas Nematode and Diagnostic Laboratory identified and counted the nematodes in over 1700 nematode samples in excess of research samples. About 150 of the samples were for growers on a fee basis; just over 100 were from demonstrations for state and county extension personnel, verification programs, and disease diagnoses; about 25 for the state plant board; over 750 as a co-operating researcher; and over 650 in assays of soybean, wheat and cotton in conjunction with the USDA National Agricultural Statistics Service. In the assays of wheat, cotton and soybean 16, 19, and 18 species of phytoparasitic nematodes were found, respectively. At least one species of phytoparasitic nematode was found in 77.5%, 85.4% and 82.9% of the wheat, cotton and soybean samples respectively. Soybean cyst nematode was found in 40.8%, 21.4% and 64.4% of the wheat, cotton and soybean samples, respectively. Meliodogyne species (Root Knot) was found in 1.4%, 14.6% and 0.8% of the wheat, cotton and soybean samples, respectively. Measurement on over 70 populations of Longidorus spp. from North America have been completed, drawings, photography, and descriptions are underway. A new species of Trophrous is currently being described.

Publications: 87/01 to 87/12

ROBBINS, R.T., RIGGS, R.D. and VONSTEEN, D. 1987. Results of Annual Phytoparasitic Nematode Surveys of Arkansas Soybean Fields 1978-1986. Annals of Applied Nematology 1:50-55.

WEST, C.P., IZEKAR, E., OOSTERHUIS, D.M. and ROBBINS, R.T. 1987. Associations of endophytic fungus with drought tolerance and nematode resistance in tall fescue. Arkansas Farm Research 36(6):3.

67.004 CRIS0134684
BIOLOGICAL SUPPRESSION OF SOILBORNE PLANT PATHOGENS

JAFFEE B A; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4932-RRProject Type: HATCH
Agency ID: CSRS Period: 01 OCT 87 to 30 SEP 92

Objectives: To identify organisms with potential for suppression of specific soilborne pathogens. To determine the mode of action of biocontrol agents identified in Objective A.

Approach: Effects of organic amendments on population densities of 2 fungal egg parasites and their association with soil characteristics will be determined. Soil samples from peach orchard soils will be collected to determine if parasitism is density dependent. Other density-dependent parasitism factors will be studied.

67.005 CRIS0134505
MOLECULAR CHARACTERISTICS OF PLANT-PARASITIC NEMATODES

WILLIAMSON V M; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4919-H Project Type: HATCH
Agency ID: CSRS Period: 12 APR 88 to 30 SEP 92

Objectives: To identify rootknot nematode species by cellulose acetate electrophoresis. To identify DNA clones unique to nematode species or races. To locate specific genes on nematode chromosomes. To apply techniques developed above to other plant-parasitic nematodes.

Approach: We will differentiate nematode species by isozyme patterns using cellulose acetate electrophoresis, a rapid, simple alternative to polyacrylamide gel electrophoresis. We will purify DNA from nematode species and clone fragments of this DNA into a vector. DNA purified from nematode isolates will be used to probe these clones to identify race or species specific probes. Nematode chromosomes will be isolated using techniques developed for yeast chromosomes, separated by pulsed field electrophoresis, and probed with race specific probes.

67.006* CRIS0134506
ISOLATION OF A GENE CONFERRING NEMATODE RESISTANCE TO TOMATO

WILLIAMSON V M; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-4920-H Project Type: HATCH
Agency ID: CSRS Period: 12 APR 88 to 30 SEP 92

Objectives: To clone the Mi gene which confers resistance to rootknot nematodes in tomato. To investigate the mechanisms of resistance. To

transfer Mi to other plant species.

Approach: We will clone Mi by virtue of its linkage to the gene Aps-1 which encodes acid phosphatase-1. Acid phosphatase-1 will be purified and used to produce antibody and obtain peptide sequence. We will screen a cDNA library for a clone of Aps-1 and use this clone to "walk" to Mi. We will transform susceptible tomato with Mi candidates and assay for resistance to nematodes. An approach to Mi using transposon tagging is also planned. The level, localization and regulation of Mi expression will be determined. Mi will be transferred to other plant species using Agrobacterium based vectors.

67.007* CRIS0136124
MOLECULAR APPROACH TO A GENE CONFERRING NEMATODE RESISTANCE TO TOMATO

WILLIAMSON V M; Nematology; University of California, Davis, **CALIFORNIA** 95616.
Proj. No.: CA-D*-NEM-5001-CG Project Type: CRGO
Agency ID: CRGO Period: 01 JUL 88 to 30 JUN 91

Objectives: PROJ. 8800667. Mi is a dominant locus that confers resistance to root-knot nematodes when present in tomato. Our goal is to clone Mi to increase understanding of the mechanism of resistance conferred by this gene.

Approach: Mi is closely linked to Aps-1, encoding acid phosphatase-1 in tomato. Acid phosphatase-1 will be purified from cell suspension culture and used to produce antibody and obtain peptide sequence for identification of the corresponding cDNA. Using this clone and clones of other linked fragments (RFLPs) as probes, DNA from resistant and susceptible cultivars will be analyzed. Candidate clones of Mi will be obtained by "chromosome walking" techniques. We propose to identify Mi by complementation of function after transformation of susceptible tomato cultivars with candidate clones using Agrobacterium based vectors.

67.008 CRIS0135594
MOLECULAR BIOLOGY OF HOST-PARASITE INTERACTIONS BETWEEN ROOT-KNOT NEMATODES AND PLANTS

BIRD D M; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4968-H Project Type: HATCH
Agency ID: CSRS Period: 22 AUG 88 to 30 SEP 92

Objectives: The goal of this project is to understand the mechanism by which root-knot nematodes induce and maintain cyncytia in the root tissue of their host. Specifically, I plan to characterize nematode exudates, the signals that trigger exudate production and the transcriptional events that occur in root tissue during nematode infection.

Approach: Antibodies raised against nematode exudates will be used to select the genes encoding these proteins from a genomic expression library. Genomic clones will be characterized by standard methods, including DNA sequencing. Expression of these genes will be examined, and selected genes will be expressed in bacteria for injection experiments. Differential cDNA libraries also will be constructed from normal and infected root tissue.

67.009 0138355
MOLECULAR CHARACTERIZATION OF THE ROOT-KNOT NEMATODE/HOST INTERACTION

BIRD D M; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-5106-CG Project Type: CRGO
Agency ID: CRGO Period: 01 JUL 89 to 30 JUN 90

Objectives: PROJ. 8900831. The goal of this project is to begin to understand the mechanism(s) by which root-knot nematodes induce and maintain syncytia in the root tissue of their host. Specifically, I plan to characterize nematode stylet-exudates, the signals that trigger exudate production, and transcriptional alterations in root tissue during nematode infection.

Approach: Nematode genes encoding stylet-exudate proteins will be cloned either from expression libraries (using anti-exudate Abs) or directly, using primers designed from partial sequence of exudate protein. These genes will be characterized, and their expression investigated. Their products will be overproduced for functional, biochemical analysis. Differential, plant-root cDNA libraries will be constructed.

67.010 CRIS0013643
CHEMISTRY OF NEMATODES AND NEMATICIDES

CASTRO C E; Nematology; University of California, Oakland, **CALIFORNIA** 94612.
Proj. No.: CA-R*-NEM-2006 Project Type: STATE
Agency ID: SAES Period: 01 OCT 88 to 30 SEP 93

Objectives: Characterize substances from plant roots that elicit chemotaxis by plant parasitic nematodes & determine power & nature of other substances to do this. Synthesize new substances of heterocyclic class that contain possible anthelmintic groupings & obtain their nematicidal activity. Determine chemistry & mechanism of oxidation & reduction of iron porphyrins & heme proteins by nematicides & environmental toxics. Determine scope, chemistry, kinetics & mechanism of the metabolism of a series of alkyl halides by selected organisms.

Approach: Organic, inorganic chemistry and biochemistry, biology. Quantitative bioassays, product isolation & characterization, synthesis, kinetics, enzyme isolation, active site modeling, whole cell reactions UV-VIS, IR, NMR, MS, VPC, HPLC, TLC, radiotracers, etc.).

Progress: 87/01 to 87/12. Irradiation of dilute aqueous solutions of 1,2-dibromo-3-chloropropane 1 with a 450-W medium-pressure mercury lamp results in a rapid photohydrolysis (t(1/2)=25 min) to the isomers 2-bromo-3-chloropropanol-1 2 (72%) and 1-bromo-3-chloropropanol-2 3 (28%). Both 2 and 3 undergo sequential photocatalyzed conversions to nonhalogenated products. The former is converted to acrolein polymer via the sequence 3-chloropropanaldehyde yield acrolein yield acrolein polymer. The latter 3 is converted to a mixture of products including chloroacetone, epichlorohydrin, and 1-chloropropanol-2, but the predominate pathway leads to glycerine and hydroxyacetone via the intermediat 1-chloro-2,3-dihydroxypropane. The overall conversion of 1 to acrolein is fast, with the slowest step having a t(1/2) of 41 min. However, the path to glycerine and hydroxyacetone proceeds with a final t(1/2) of 58 h. The branched reaction and rates for each step are presented. The rate enhancement for the hydrolysis of 1 by photolysis is difference 10 .

Publications: 87/01 to 87/12

CASTRO, C.E., MAYORGA, S. and BELSER, N.O. 1987. Photohydrolysis of 1,2-Dibromo-3-Chloropropane. J. Agr. Food Chem. 35:865-870.

67.011* CRIS0086370

MANAGEMENT AND RELATED BIOLOGY OF NEMATODE PARASITES OF FIELD AND VEGETABLE CROPS

ROBERTS P A; THOMASON I J; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-4187 Project Type: STATE Agency ID: SAES Period: 01 NOV 87 to 30 SEP 92

Objectives: Determine distribution and abundance of nematodes. Define host-parasite relationship and pathogenicity of new or poorly understood nematodes. Study population dynamics, soil distribution, survival, damage threshold levels of nematodes, singly and in mixed populations, and influence of biological and physical environment on nematodes and crop injury. Develop nematode management programs utilizing biological, chemical, cultural, and resistance strategies.

Approach: Survey, isolate, identify, and culture nematodes associated with crop damage. Inoculate plants and measure host response as influenced by environment, under greenhouse and field conditions. Evaluate and refine management strategies on nematode infested field sites.

Progress: 87/01 to 87/12. Rotation studies continued for a second year to examine impact of Meloidogyne spp. resistant tomatoes on multiseason nematode population dynamics. Susceptible crops of cotton, Acala SJ2, and freezer beans, Massy M16 and Dixie Buttercup, grown on 1,3-D fumigated and nonfumigated plots following a previous planting to resistant tomato on infested fields showed no response to fumigation. These results clearly demonstrate utility of resistant tomato in protecting succeeding crops by reducing nematode populations. Metham-sodium drip-applications to vegetable planting beds were monitored by horizontal and vertical grid-core samplings to determine distribution of liberated MIT in soil profiles. Significant accumulation of MIT occurred in upper 30-45 cm depth, and increased application water improved penetration. An in-field MIT monitoring probe is being developed for rapid assay of MIT levels. Expression of Meloidogyne incognita and M. javanica resistance was demonstrated in a synthetic hexaploid wheat, derived from Aegilops squarrosa. Inheritance study tests with F(2) progeny suggest a simple dominant gene for resistance in Ae. squarrosa. Combined seed (phenamiphos), soil (ethoprop), and foliage (oxamyl) treatments (designed to reduce nematicide load in soil) for control of Heterodera schachtii on sugar beet were tested in the summer of 1987 in Riverside. Combined treatments were no better than soil treatment alone.

Publications: 87/01 to 87/12

LESTER, R.N. and ROBERTS, P.A. 1986. Serotaxonomy of Solanum, Capsicum, Dunalia and other selected Solanaceae. Ann. Missouri Bot. Gard. 73:128-133.

RADEWALD, J.D., MCKENRY, M.V., ROBERTS, P.A. and WESTERDAHL, B.B. 1987. The importance of soil fumigation for nematode control. Calif. Agric. 41(11 and 12):16-17.

ROBERTS, P.A. and THOMASON, I.J. 1988. Screening of a granular chelate of metham zinc for nematicidal activity using citrus and root-know nematodes. Ann. of Appl. Nematol. 2 (in press).

ROBERTS, P.A., MAGYAROSY, A.C., MATTHEWS, W.C. and MAY, D.M. 1988. Effects of metham sodium applied by drip irrigation on soil populations of root-knot nematodes, Pythium ultimum and Fusarium sp., and infection of carrot and tomato roots.

KALOSHIAN, I., ROBERTS, P.A. and THOMASON, I.J. 1987. Expression of resistance to Meloidogyne javanica in a synthetic allohexaploid developed from durum wheat and Aegilops squarrosa. J. Nematol. 19:534.

67.012* CRIS0072864

ECOLOGY OF NEMATODES IN AGRICULTURAL AND NONAGRICULTURAL SOILS

VAN GUNDY S D; Nematology; University of California, Riverside, **CALIFORNIA** 92521.
Proj. No.: CA-R*-NEM-3558 Project Type: STATE Agency ID: SAES Period: 01 JUL 85 to 30 SEP 91

Objectives: To study the interrelationships and survival of nematode trophic groups in soil and their interactions with environmental factors, plant roots, root rhizosphere, soil microflora and soil fauna to gain an understanding of the

soil ecosystems.

Approach: Examine nematode community structure in natural and agricultural soils both in the field and in the greenhouse. Focus will be on the root rhizosphere-plant root-soil biota system of both perennial and annual plant systems. Studies will also include interactions with microarthropods, mycorrhize, rhizobia and insect herbivores. Research will be carried out at University of California, Riverside, New Mexico State University, and Texas Tech University.

Progress: 87/01 to 87/12. A deep rooting symbiotic plant (mesquite, Prosopis glandulosa) occurs at four different ecosystems on the NSF Jornada LTER site near Las Cruces, NM. Effects of nematodes & soil micro-arthropods on symbiont function were examined at depth. Nematodes of all tropic groups occurred at 12 and 13m, including Xiphinema sp. The nematode community was highly correlated with TKN, ND3 and Pi. However, the trophic groups responded differently to soil properties, i.e., fungivores were more highly correlated with Pi. Initial results indicate deep root systems have biotic activity similar to surface soils. A field experiment in which 600 sterile, 2m-long soil tubes were placed into the desert to measure root and rhizophere development over time, is being analyzed. A model of the nematode bacterivore, (Acrobeloides sp.) was used to examine activity patterns of free-living nematodes in deserts. Eggs & larvae develop quickly at warm temperatures (Lab results) providing a high potential growth rate for the population when moisture is not limiting. Predicted activity patterns were consistent with field observations of nematode-related decomposition processes. Studies on C allocation, using C, in two ecotypes of the Serengeti Panicum grass, as affected by grasshoppers, nematodes and VAM, are being conducted at Duke Univ. Carbon transport speed is slower to nematode infected roots, but the C export pool in nematode infected roots is greater than control plants.

Publications: 87/01 to 87/12

MOORHEAD, D.L., FRECKMAN, D.W., REYNDLDS, J.F. and WHITFORD, W.G. 1987. A Simulation Model of Soil Nematode Population Dynamics: Effects of Moisture and Temperature. Pedobiologia 30:361-372.

VAN GUNDY, S.D. 1987. Perspectives on Nematology Research. In: J.A. Veech and D.W. Dickson (eds.). VISTAS on Nematology. Chapter 5. Society of Nematologists, Inc. Pp. 28-31.

67.013* CRIS0134378

ASSESSING YIELD LOSS DUE TO CROP DAMAGE IN TERMS OF INTERCEPTED LIGHT

FERRANDINO F J; Plant Pathology & Ecology; Connecticut Agri Expt Station, New Haven, **CONNECTICUT** 06504.

Proj. No.: CONH00692 Project Type: HATCH
Agency ID: CSRS Period: 01 MAR 88 to 29 FEB 92

Objectives: Determine the relation between yield and crop damage caused by disease and insects by answering the questions: How is the total light energy intercepted by healthy leaves related to final yield for plants damaged by: diseases which cause rapid defoliation, diseases characterized by local lesions, wilt diseases, and insect herbivory? How is the net assimilation, dark respiration, and partitioning of photosynthate affected by disease and herbivory.

Approach: The relationships among the total plant dry weight, the dry weight of marketable yield and the total light intercepted by the plant over the growing season will be examined for several crop-pest systems including potato, defoliated by late blight and Colorado potato beetles, tomato affected by early blight, snap beans affected by bean rust, corn affected by corn rust, and tobacco attacked by nematodes. Yields from manually defoliated sections of control plots will be compared to the yields from areas sustaining damage by pests. Intercepted light will be measured using tube solarimeters. The severity of damage including fallen vegetation, will be measured. Final dry weight of the various organs of the plants will be determined and the quality of the final marketable product will be estimated. The rate of total dry weight increase per unit light energy intercepted will be estimated graphically from a plot of total plant dry weight versus total intercepted light.

67.014* CRIS0141452

BIOREGULATION OF INSECT-PLANT INTERACTIONS

MAYER R T; SCHROEDER W J; SHAPIRD J P; Agricultural Research Service, Drlando, **FLORIDA** 32804.

Proj. No.: 6617-24000-004-00D
Project Type: INHDUSE
Agency ID: ARS Period: 28 MAY 86 to 27 MAY 91

Objectives: Determine effect of plant products on insect reproduction, feeding, digestion, hormones, and chitin metabolism. Characterize vector relationships and phytoalexins in resistant plants. Identify and characterize biological control agents for insect pests, and develop control systems for their application.

Approach: Involves use of diverse techniques including methods in histology, electrophoresis, spectroscopy, fluorimetry and bioassay and immunoassay (ELISA, RIA, SSEM, fluorescent antibody), microscopy (TEM, SEM, LM), probes(dsRNA, antibody, fluorescent, and cDNA), centrifugation, chromatography (affinity, TLC, gel, HPLC), microscopy, isotopes, hemagglutination, and hybridomas.

Progress: 87/01 to 87/12. A bioassay was developed using Mexican lime leaves on an agar media in petri dishes that allows assessment of virulence of Verticillium sp. against citrus aphids; the assay is facile and provides a more rapid method for determination of fungal biocontrol agents to control citrus aphids. Use

of a nematode (Steinernema feltiae) isolated from infected larvae of Diaprepes abbreviatus coupled with a new method to increase the efficacy of the entomogenous nematode was shown to reduce citrus root weevil populations to economic threshold levels not previously attainable. These methods will be of interest to all biocontrol programs that utilize nematodes as the biocontrol agents and to the citrus industries in Florida and the Caribbean Basin. Spectrofluorometric studies showed that natural and synthetic xenobiotics (coumarins) are absorbed by hemolymph proteins after ingestion. A model system was subsequently developed to observe binding to hemolymph proteins in vivo and in vitro and to determine if it is possible to alter the dynamics of binding and absorption such that a control method can be developed. An in vitro, cell-free assay for chitin synthase has been developed utilizing gut tissue from D. abbreviatus larvae; this method will allow for testing of chitin synthesis inhibitors against the citrus root weevil and for investigations on the chitin metabolic pathway in this insect.

Publications: 87/01 to 87/12

SCHRDEDER, W.J. 1987. Laboratory bioassays and field trials of entomogenous nematodes for control of Diaprepes abbreviatus (Coleoptera: curculionidae) in citrus. Environ. Entomol. 16:987-989.

SCHRDEDER, W.J. and BEAVERS, J.B. 1987. Movement of the entomogenous nematodes of the families heterorhabditidae and steinernematidae in soil. J. Nematol. 19(2):257-259.

SCHRDEDER, W.J. 1987. Induced pupation in Diaprepes abbreviatus (Coleoptera: curculionidae). Fla. Entomol. 70(1):186-187.

SHAPIRD, J.P. 1988. Isolation and fluorescence studies on a lipophorin from the weevil Diaprepes abbreviatus. Arch. Insect Biochem. Physiol. (Accepted December 1987).

CHEN, A.C., KIM, H.R., MAYER, R.T. and NDRMAN, J.D. 1987. Vitellogenesis in the stable fly, Stomoxys calcitrans. Comp. Biochem. Physiol., 88B(3):897-903.

MAYER, R.T. et al. Evidence that chitin synthesis inhibitors affect cell membrane transport. Proc. Intern. Conf. on Endocrinological Frontiers in Physiological Insect Ecology. (Accepted September 1987).

SHAPIRD, J.P., LAW, J.H. and WELLS, M.A. 1988. Lipid transport in insects. Annu. Rev. Entomol. 33:297-318.

67.015* CRISO134370

EFFICIENT MANAGEMENT OF MULTIPLE-CROPPING, MINIMUM-TILLAGE SYSTEMS

GALLAHER R N; Agronomy; University of Florida, Gainesville, **FLORIDA** 32611.

Proj. No.: FLA-AGR-02563 Project Type: HATCH
Agency ID: CSRS Period: 01 DCT 88 to 30 SEP 93

Objectives: Determine multiple-cropping and minimum-tillage system combinations for year-round crop production. Determine soil fertility, chemistry, and physics; cultural aspects of the crops; tillage; pest; and equipment management.

Approach: People in Florida and the southeast are more aware today than ever before that multiple cropping aids in efficient utilization of expensive farming resources. Research studies will be conducted in the following areas: nitrogen and potassium fertilization of a no-tillage rye-soybean, double cropping system, soil fertility, chemical, and physical properties affected by time, location, cropping system, and tillage, etc. Soil will be collected from long-term studies from other locations outside of Florida for comparison with Florida data.

Progress: 88/01 to 88/09. Crop yields are often reduced by nematode infestations. Dne study was completed that determined the effect of two double cropping systems under two tillage systems on infestation of four nematode species. The vetch/corn cropping system increased the root-knot nematode population by 290% compared to the vetch/grain sorghum double cropping system. In contrast, the vetch/grain sorghum sequence increased the ring nematode population by 65% compared to the vetch/corn cropping system. Conventional and no-tillage treatments were equally infested by nematodes. In another oat/soybean double cropping study total soybean and oat root dry weight was equal for both conventional and no-tillage treatments after 10 years of tillage and cropping history. However, no-tillage had more root dry weight (79% of the total) in the upper 10 cm soil layer for soybean and in the upper 5 cm (85% of the total) for oat, as compared to the conventional treatment. This high concentration of roots near the soil surface in no-tillage has implications for management of fertilizer and water for no-tillage double cropping systems.

Publications: 88/01 to 88/09

GALLAHER, R.N., DICKSON, D.W., CDRELLA, J.F. and HEWLETT, T.E. 1988. Effect of tillage and multicropping systems on the population dynamics of phytoparasitic nematodes. Anals of Applied Nematology. Accepted for publication.

ORTIZ, R.A. and GALLAHER, R.N. 1988. Evaluacion economica y respuesta del doble cultivo centeno soja a la aplicacion de nitrogeno y potasio en un sistems de labranza cero. Gaceta agronomica (Buenos Aires, Argentina). VIII (No. 43).

CORELLA, J., GALLAHER, R.N. and DICKSDN, D.W. 1988. Effect of tillage and vetch-corn versus vetch-grain sorghum succession multicropping systems on population dynamics of phytoparasitic nematodes. Agronomy Dept., IFAS, Univ. of FL.

BUSTILLD, J. and GALLAHER, R. N. 1988. Partitioning of dry matter in fall-grown, no-tillage tropical corn in Florida. Agronomy Dept., IFAS, Univ. of FL, Agronomy Res. Rept. AY 88-04.

BRUNIARD, G.C. 1988. Double-cropped soybean/oat root growth and development affected by tillage. M.S. thesis, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.

ORTIZ, R.A. 1988. Nitrogen and potassium fertilization of a no-tillage rye-soybean double-cropping system. Ph.D. dissertation, Agronomy Dept., IFAS, Univ. of FL, Gainesville, FL 32611.
VAZQUEZ, L., MYHRE, D.L., GALLAHER, R.N., HANLON, E.A. and PORTIER, K.M. 1988.

67.016 CRIS0132511
EVALUATION OF ALGAL PRODUCTS FOR CONTROL OF ROOT-KNOT NEMATODES

TARJAN A C; Entomology & Nematology; University of Florida, Gainesville, **FLORIDA** 32611.
Proj. No.: FLA-ENY-02641 Project Type: STATE
Agency ID: SAES Period: 15 JUL 87 to 30 SEP 92

Objectives: To test preparations of marine, brackish-water and fresh water algae for inimical effects on growth of root-knot nematodes induced galls, subsequent host plant growth, and infectivity of juveniles. To conduct in vitro bioassays on Meloidogyne J-2 juveniles using extracts derived from aquatic algae. To further test promising algal candidates in greenhouse and field experiments.

Approach: Adequate quantities of aquatic fungi will be collected, then processed for future testing. The dried materials will be finely ground, sifted and then refrigerated in sealed containers. Liquid fractions of algae, obtained by maceration of tissues and centrifuging, will be tested at various strengths using Meloidogyne juveniles. Tomato seedlings will be inoculated with eggs of Meloidogyne. Dried ground algal meals will be mixed with the soil at various percentages. Data will be collected in 8-10 weeks.

Progress: 87/10 to 88/09. Nineteen marine algae from the Atlantic and Gulf coasts of Florida, and two fresh-water algae were collected, refrigerated and then either freeze-dried or forced-air dried. After being finely ground, they were applied as soil amendments in concentrations of 0.25 to 1.00% by weight of soil to tomato plants growing in 15-cm clay pots. The tomato plants had been inoculated 2 weeks previously with 1725 to 3000 eggs of the nematode Meloidogyne incognita, depending on the test. Five replicated glasshouse trials were conducted from March, 1986 through May, 1987. Each test was harvested about two months after the algae were incorporated into the soil. Data obtained were dry weight of aerial parts and fresh root weight. Each root system was cut into 13-mm pieces, thoroughly mixed and a 1-g aliquot was selected at random; root knots were counted. The data were statistically analysed using the Duncan-Waller Multiple Range Test. Plants treated with Ulva lactuca at 0.5 to 1.0% by weight of soil had significantly fewer knots than untreated control plants. The only test that lacked statistical significance of the 5 which were conducted resulted in a 35% reduction of root-knot in tomato plants treated with Ulva as compared to untreated plants. Treatment of the soil with U. lactuca usually resulted in significantly heavier aerial parts and root weights.

Publications: 87/10 to 88/09
TARJAN, A.C., FREDERICK, J.J., DAVIS, J.S. and BATES, R.P. 1989. Suppression of Meloidogyne infection in tomato with soil amendments of the marine alga, Ulva lactuca. (Abstr.) Nematologica. in press.

67.017* CRIS0142342
INTEGRATING CONSERVATION TILLAGE & PEST MANAGEMENT WITH IRRIGATED COTTON, SOYBEAN AND TRITICALE

DOWLER C C; JOHNSON A W; Agricultural Research Service, Tifton, **GEORGIA** 31794.
Proj. No.: 0500-21010-002-29D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 87 to 30 SEP 91

Objectives: To utilize irrigation application technology with new and improved integrated pest management systems for controlling weeds, nematodes, insects, and diseases in a multiple-cropping system of triticale-cotton-soybean grown under irrigated conservation tillage.

Approach: Multiple-cropping sequences of triticale-soybean, triticale-cotton or triticale-cotton-triticale-soybean will be studied. Experiments will integrate optimum and minimum pest management levels on the sequences grown in conservation tillage, and measure the allelopathic and residue management factors of triticale, cotton, and soybean. Soil pest population dynamics will be studied. Irrigation application technology will be utilized to apply crop production materials. Economic profitability, mathematical programming, and simulation models will be developed.

Progress: 87/10 to 87/12. Four tillage treatments (ridge-plant, no-till, row-till, deep-turn) were established on a winter crop of triticale following cotton. Yields of triticale from deep turn plots were 22% greater than yield from ridge-plant plots. Following triticale harvest, the residue was mowed tall (61 cm), mowed short (20 cm), or burned. Cotton (McNair 235) was planted in plots with the four tillage treatments. Yields from plants in deep-turn, row-till, and ridge-plant plots were 27%, 13%, and 7% greater, respectively, than yield from no-till plots. Triticale and cotton yields were affected by previous intensive cropping systems. Yield of cotton and nematode population densities were not affected by triticale residue management. Fenamiphos in combination with fluometuron or metribuzin increased injury to cotton and soybean, respectively. Irrigation application technology was successfully used to apply fertilizer, herbicide, nematicide, and insecticide.

Publications: 87/10 to 87/12
ND PUBLICATIONS REPORTED THIS PERIOD.

67.018* CRIS0095605
MANAGEMENT OF HETERODERA GLYCINES AND MELOIDOGYNE INCOGNITA ON SOYBEAN

HUSSEY R S; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000865 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 85 to 30 SEP 90

Objectives: Management of Heterodera glycines and Meloidogyne incognita on soybean. Identify the biologically active molecules secreted by M. incognita that elicit the susceptible response in plants.

Approach: Damage thresholds of root-knot and cyst nematodes resistant compared to susceptible cultivars will be determined in microplots. Soybean germplasm will be evaluated for SCN tolerance. Breeding lines with resistance to SCN races 3 and 4 in their parentage will be screened in heavily infested fields. Interactions between SCN and M. incognita (MI) will be investigated. Immunogen preparation: Secretions or secretory granules will be collected and evaluated using three different methods. Antibody Production: Because of limited quantity of immunogen two approaches to antibody production will be used; 1) immunize mouse cells in vitro by procedure of Van Ness et al, and 2) the more conventional in vivo immunization, but to immunize mice in optimal fashion.

Progress: 87/01 to 87/12. Interactions among Meloidogyne incognita (Mi), Pratylenchus brachyurus, (Pb), and soybean genotype on plant growth and nematode reproduction were studied in a greenhouse. Coker 317 (susceptible to both nematodes) and Gordon (resistant to Mi, susceptible to Pb) were inoculated with increasing initial population densities (Pi) of both nematodes individually and combined. Mi and Pb individually usually suppressed shoot growth of both cultivars, but only root growth on Coker 317 was influenced by a MixPb interaction. Reproduction of both nematodes, although dependent on Pi, was mutually suppressed on Coker 317. Pb reproduced better on Gordon than on Coker 317 but did not affect its resistance to Mi. Root systems of Coker 317 were split and inoculated singly or combined with Mi and Pb to determine the nature of the interaction. Mi suppressed reproduction of Pb either when co-inhabiting a half-root system or infecting opposing half-root systems; however, Pb affected Mi only if both nematodes infected the same half-root system. The effect of concomitant infection on penetration of soybean roots by either species was studied. More second-stage juveniles of Mi penetrated roots of Coker 317 than roots of Gordon soybean whereas Pb more readily penetrated roots of Gordon than Coker 317. Neither nematode species affected root penetration by the other species on dually inoculated plants harvested at 4, 8, or 12 days after inoculation.

Publications: 87/01 to 87/12
HUSSEY, R.S. 1987. Secretions of esophageal glands of Tylenchida nematodes. Pages 221-228. In Vistas on Nematology, J.A. Veech and D.W. Dickson, eds. Hyattsville: Society of Nematologists.

HUSSEY, R.S. and MCGUIRE, J.M. Interaction with other organisms. Pages 293-328. In Principles and practices of nematode control in crops. R.H. Brown and B.R. Kerry, eds. Orlando: Academic Press.

BOERMA, H.R., HUSSEY, R.S. and REESE, P.F., JR. 1986. Tolerance to soybean cyst nematode. Pages 76-83 In Proceedings of the 16th Soybean Seed Research Conference. Washington: American Seed Trade Association.

HERMAN, N. 1986. Interaction between Meloidogyne incognita and Pratylenchus brachyurus on soybean. M.S. Thesis. University of Georgia.

REESE, P.F., JR., BOERMA, H.R. and HUSSEY, R.S. 1987. Heritability of tolerance to Heterodera glycines in soybean. Agronomy Abstracts. Page 77.

WALLER, R.S., BOERMA, H.R. and HUSSEY, R.S. 1987. Natural selection for soybean cyst nematode resistance. Agronomy Abstracts. Page 83.

67.019* CRIS0131228
BIOLOGY OF GENETICALLY CHANGING ROOT-KNOT AND CYST NEMATODES OF SOYBEAN

HUSSEY R S; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000923 Project Type: HATCH
Agency ID: CSRS Period: 01 JAN 87 to 30 SEP 91

Objectives: To elucidate changes in behavior of nematodes resulting from crop manipulation. To develop efficient systems for integrating and deploying germplasm, cultural tactics, and biological antagonists to manage Meloidogyne species and Heterodera glycines.

Approach: The interaction of soybean germplasm resistance and nematode virulence will be determined in a uniform regional test. All cultivars, advanced breeding lines, and other suitable material will be distributed to all project leaders. Each cultivar will be tested with several different isolates of H. glycines and major species and race of meloidogyne for reproduction and compared to a standard susceptible host. Nematode races and species will be monitored by standard differential host tests for regional shifts in race and species composition. Experiments will be conducted to find biotic and abiotic factors that influence population densities of root-knot and cyst nematodes. Selected soybean lines tolerant of nematode development will be evaluated regionally against several nematode isolates, in cooperation with plant breeders. The effects of root morphology and growth pattern on nematode invasion and development will be evaluated.

Progress: 87/01 to 87/12. Soybean genotypes (2,370) in the Southern Germplasm Collection (MG V, VI, VII, and VIII) were sequentially screened in a greenhouse to identify the highest levels of resistance to M. incognita (Mi), M. arenaria (Ma) and M. javanica (Mj) based on root galling and nematode reproduction. After three levels of screening using an inoculum density of 2,000 nematode

eggs per plant, 61, 56, and 61 genotypes were identified as resistant to Mi, Ma, and Mj, respectively. In the next two screening levels, three inoculum densities were used to differentiate the levels of resistance among these genotypes. The screening for Mi identified 'Amredo', PI96354, PI408088, and PI417444 with lower gall indices, fewer eggs per root system, and eggs per gram of root than 'Forrest', the resistant check. In the Ma screening PI200538 and PI230977 had lower gall indices and fewer eggs per root system than 'Jackson', the resistant check. The Mj screening identified PI230977 with a lower gall index than 'Gordon', the resistant check. Two of the genotypes (PI 96354, PI 417444) highly resistant to Mi were grown in field microplots with increasing initial population densities (Pi) of Mi. Boosier and Forrest were the susceptible and resistant checks, respectively. Pi were 0, 31, 125, and 500 eggs/100 cm . Fewer second-stage juveniles (J2) penetrated PI 96354 at 14 days after inoculation than the other genotypes. Mi J2 population densities were directly related to Pi at 60 and 90 days for all genotypes.

Publications: 87/01 to 87/12

LUZZI, B.M., BOERMA, H.R. and HUSSEY, R.S. 1987. Resistance to three species of root-knot nematode in soybean. Crop Science 27:258-262.

HUSSEY, R.S. and BOERMA, H.R. 1987. Greenhouse ratings for resistance to soybean cyst nematode and three species of root-knot nematode. Pages 30-31. In 1986 field crops performance tests.

67.020 CRIS0134843

CROPPING SYSTEMS ANALYSIS FOR LIMITING LOSSES DUE TO PLANT-PARASITIC NEMATODES

NOE J P; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000506 Project Type: HATCH
Agency ID: CSRS Period: 01 JUN 88 to 31 MAY 93

Objectives: To increase the profitability of selected Georgia cropping systems through optimal deployment of available management alternatives, resulting from systems analyses of nematode/crop/economic relationships.

Approach: To establish replicated grids of research plots in naturally-infested fields, such that a wide range of nematode densities occur among the plots, and to monitor nematode population dynamics and crop performance in the plots. To characterize quantitative models which represent nematode/host relationships, and to combine these models into comprehensive simulations of the selected cropping systems. Additional epidemiological details necessary for various model parameters will be determined in greenhouse controlled-environment chambers. To combine the nematode/crop models with economic data by formulating linear programming systems. The resulting system will be optimized by quantitative decision-making techniques.

67.021 CRIS0095603

USE OF ENDOMYCORRHIZAE AS BIOLOGICAL FERTILIZERS AND BIOCONTROL AGENTS

RONCADORI R W; Plant Pathology; University of Georgia, Athens, **GEORGIA** 30602.
Proj. No.: GE000867 Project Type: HATCH
Agency ID: CSRS Period: 01 JUL 85 to 30 JUN 90

Objectives: To develop more efficient VAM fungi-plant host relationships as a subsequent basis for improving their practical performance as biological fertilizers and biocontrol agents, and 2) to develop several VAM fungi-plant host systems which will perform efficiently, uniformly, and predictably in commercial agriculture using information from objective 1.

Approach: A. General - Accepted procedures will be used to extract VAM fungal inoculum from the soil. Inoculum will be increased in pot culture, extracted, quantified, and used in research with seed or rooted cuttings. Mycorrhizal development will be determined. Nematodes will be propagated in the greenhouse, eggs collected, and nematode inoculum added at an appropriate time after transplanting or seeding. Nematode development and plant damage will be determined. B. Procedures for Objective 1 - establish new cultures collected from different crops and locations to establish a stock of regionally adapted isolates, 2) infest soil-less media with selected VAM fungi to determine effect of medium composition and fertility rate on plant growth, percent mycorrhizal colonization, and transplantability.

Progress: 87/01 to 87/12. The effect of the vesicular-arbuscular mycorrhizal fungus, Gigaspora margarita, on the growth and development of sweetgum (Liquidambar styraciflua) at two phosphorus levels in a loamy sand soil and in kaolin mine spoil was studied by determining total biomass production, growth rate, foliar nutrient content and mycorrhizal development in 161-day-old seedlings. Non-mycorrhizal seedlings grew best in a loamy sand soil supplemented with 100 mu g P g , but in kaolin spoil did not respond to this rate of fertilization unless they were mycorrhizal. In soil receiving 25 mu g P g , growth rate of mycorrhizal seedlings was significantly greater than that of non-mycorrhizal seedlings and foliar levels of P, Mg and Ca were enhanced by both mycorrhizal colonization and P fertilization. Mycorrhizal development and spore production were suppressed at the high P level. The role of VA-mycorrhizal fungi as biocontrol agents toward root knot nematode on cotton is being investigated. Mycorrhizal fungi may suppress nematode egg production and we are investigating the mechanism involved with emphasis on terpenoid aldehydes which are phytoalexins. At this point, mycorrhizae do not appear to alter the location of production of these compounds. We are now trying to evaluate the mycorrhizal effect on rapidity and concentration on their synthesis.

Publications: 87/01 to 87/12

GRUHN, C.M., RONCADORI, R.W. and KORMANIK, P.P. 1987. Interaction between a vesicular-arbuscular mycorrhizal fungus and phosphorus fertilization on sweetgum growth in loamy sand and kaolin spoil. Reclam. and Reveg. Res. 6:197-206.

PRICE, N.S., RONCADORI, R.W. and HUSSEY, R.S. 1988. Tolerance of cotton to Meloidogyne incognita as influenced by soil fertility and a vesicular-arbuscular mycorrhizal fungus. Ann. Appl. Biol. (In Press).

PRICE, N.S., RONCADORI, R.W. and HUSSEY, R.S. 1987. Cotton root growth as influenced by phosphorus nutrition and vesicular-arbuscular mycorrhizae. The New Phytologist. (In Press).

PRICE, N.S., HUSSEY, R.S. and RONCADORI, R.W. 1987. The interaction between soil phosphorus, Heterodera glycines, and Glomus intraradices on nematode 'intolerant' and 'tolerant' soybeans. Plant Disease: (In Press).

67.022 CRIS0096867

IDENTIFICATION/CHARACTERIZATION OF LIVING MULCHES FOR NEMATODE SUPPRESSION IN CROPPING SYSTEMS

DEFRANK J; TANG C S; CASWELL E P;
Horticulture; University of Hawaii, Honolulu, **HAWAII** 96822.

Proj. No.: HAW00810-G
Project Type: SPECIAL GRANT
Agency ID: CSRS Period: 01 AUG 85 to 31 JUL 89

Objectives: Determine the nematode suppressing activity of selected plant species. Isolate and identify compounds with nematode suppressing activity from root exudates.

Approach: Develop a bioassay using marigold as a model system to determine the effect of root exudates on nematode egg hatching and use the developed bioassay as well as greenhouse and field tests using naturally infested soils to identify plant species with nematode suppressing activity. Root exudates will be collected by XAD-4 resin using a continuous root exudate trapping system and identify compounds by methodology which could include the HPLC, GLC and GC-MS.

Progress: 86/10 to 87/09. Mass production of reniform nematode, Rotylenchulus reniformis, eggs has been completed. Preliminary studies determined the effect of chemicals required to enhance the solubility of test substrates in an aqueous egg hatching solution. Ethanol at 1 ppm had no effect on rate of egg hatch. The emulsifying agent Tergitol 15-S-7 was evaluated at 0, .2, 2, 4, 8 and 24 ppm on egg hatch. All levels of Tergitol reduced the rate of egg hatch, thus limiting its usefulness in future testing. Greenhouse studies have elucidated the effectiveness of rhodesgrass (Chloris gayana) and marigold (Tagetes patula) to reduce the number of reniform nematodes in the soil and the number of females in host root tissue. Results indicated that both plant species may reduce total nematode populations in the soil. These effects are negated when susceptible host roots are present in the same pot. Studies with root exudates from undisturbed rhizospheres of marigold, tomato (susceptible host) and rhodesgrass were evaluated in reinform infested field soil. These studies were designed to determine if root exudates could protect susceptible host plants from reinform infection. Results indicated that reinform root finding abilities may be impaired in the presence of any root exudates not present as a gradient. Research continues to improve the reliability of the in vitro egg hatch and to elucidate ecological significance of root exudates on reinform pathogenicity.

Publications: 86/10 to 87/09

NO PUBLICATIONS REPORTED THIS PERIOD.

67.023 CRIS0048242

STUDIES ON UTILIZATION OF TOXIC PLANTS FOR CONTROL OF NEMATODE PESTS OF ECONOMIC PLANTS

FASSULIOTIS G; BHATTI D B; Nematology; Haryana Agricultural University, Hissar, **INDIA**

Proj. No.: 8001-24000-197-00P
Project Type: GRANT
Agency ID: OICD Period: 01 APR 83 to 31 MAR 88

Objectives: To screen wild plants, shrubs and cultivated plants for nematicide activityand to isolate the active principles.

Approach: Plant parasitic nematodes of economic importance and microorganisms associated with the rhizosphere will be identified. Water and organic solvent extracts from plant roots at various concentrations will be evaluated for toxicity to nematode juveniles and to the microorganisms. Thermal stability, pH and storage of extracts for various durations will be tested for activity. Toxic extracts will be processed for isolating and identifying the active component(s) by column chromatography, TLC, CLC, etc.

Progress: 87/01 to 87/12. Leaf extracts of seven plants, viz., Mentha piperita, Eucalyptus naundina, Cirsium arvense, Calotropis procera, Ricinus communis, Bougainvillia spectabilis and Leucaena leucocephala found effective against nematodes, were tested against six beneficial and harmful fungi, viz., Paecilomyces lilacinus, Rhizoctonia solani, R. bataticola, Aspergillus nidulans, Alternaria alternata and Cephaliophora irregularis. All extracts except those of L. leucocephala and C. arvense inhibited the growth of A. alternata. The growth of C. irregularis was inhibited in only one extract, i.e. B. spectabilis. Leaf extracts of R. communis, C. procera and E. naundina increased the growth of A. nidulans while M. piperita, C. arvense, B. spectabilis and L. leucocephala inhibited the growth. All the extracts were inhibitory to Rhizoctonia spp. except E. naundina. Inhibition was dependent on concentration of extract. The nematicidal activity of various phenols, ethyl (aryloxy) acetates and their hydrazides was determined against second-stage larvae of three nematodes, viz., Anguina tritici, Meloidogyne javanica and Heterodera cajani. The phenols with chloro or electron donating substituents and ethyl

(aryloxy) acetates were found to show good nematicidal activity while the hydrazides were active. The activities are correlated with chemical constituents.

Publications: 87/01 to 87/12
MALIK, M.S., SANGWAN, N.K., DHINDSA, K.S., VERMA, K.K., and BHATTI, D.S. 1987. Nematicidal efficacy of some monoterpenes and related derivatives. Pesticides 21(5):30-32.
MALIK, M.S., VERMA, B.S., SANGWAN, N.K., BHATTI, D.S., and DHINDSA, K.S. 1985. Phytochemical and nematicidal studies on Chenopodium species. Pl. Physiol. & Biochem. 12(2):133-138.
MALIK, M.S., SANGWAN, N.K., DHINDSA, K.S., and BHATTI, D.S. 1987. Nematicidal activity of extracts of Xanthium strumarium. Pesticides 21(10:19-20.

67.024 CRIS0130099
ISOLATION OF THE RESISTANCE GENE IN TOMATO TO THE NEMATODE MELOIDOGYNE INCOGNITA

WHITE F F; Plant Pathology; Kansas State University, Manhattan, **KANSAS** 66506.
Proj. No.: KAN09453 Project Type: CRGO
Agency ID: CRGO Period: 15 SEP 86 to 31 MAR 89

Objectives: PROJECT 8601782. The goal of this proposal is to isolate a gene which is tightly linked to a disease resistance locus in tomato. The Mi locus (nematode resistance) in tomato is tightly linked to the isozyme acid phosphatase-1 (APS-1). By isolating APS-1, we propose to clone the APS-1 gene and use the gene as the starting point for "chromosome walking" to the Mi locus.

Approach: The approach will involve isolating the APS-1 enzyme from nematode resistant tomato plants using standard protein isolation technique. The protein will be characterized and the N-terminus amino acid sequence determined. The sequence will be used to generate a oligonucleotide probe for screening a recombinant DNA library form tomato.

Progress: 87/01 to 87/12. We have devised several protocols for purification of APS-1 (acid phosphatase). One procedure was used to characterize the presumptive APS-1 monomer. A second, less extensive procedure was used for amino acid analysis. The extensive procedure was essentially as follows: Total protein was extracted from tomato seedlings by grinding the tissue in an equal volume (w/v) of cold buffer. The debris was removed by centrifugation at 8,000 rpm. Protein that was precipitated in 35% ammonium sulfate was discarded. The remaining proteins were precipitated by addition of ammonium sulfate until the solution was 95% saturated. The precipitate was pelleted, dialyzed against 0.01m histidine, pH 6.0 buffer, and filtered on a carboxymethyl cellulose (CM52) column. The eluant was then loaded on a DEAE 52 anion exchange column. The APS-1 protein binds to DEAE 52 and is eluted with a 0-400 mM NaCl gradient. After dialysis, a second DEAE 52 fractionation was performed. The fractions with APS-1 activity were then subjected to chromatofocusing. APS-1 was eluted from the chromatofocusing column at pH 4.15. The APS-1 was then bound to con-canavaline -A sepharose. Protein was eluted with a 0 to 500 mM methyl -alpha-D-Mannopyranoside gradient. Fractions containing APS-1 activity were subjected to native and SDS gel analyses. This procedure yielded an active APS-1 enzyme that appears to consist of two 28 kd monomers.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

67.025 0143918
NATURAL BIOREGULATORS & ANALOGS OF PLANT PARASITIC NEMATODES-NEW ENVIRONMENTALLY SAFE NEMATICIDES

HUETTEL R N; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-065-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 89 to 31 MAR 90

Objectives: 1) Determine effects of pheromones and analogs of soybean cyst nematode under greenhouse and field conditions; 2) isolate sex and other pheromones from other bisexual cyst nematodes; 3) develop bioassays to understand pheromones that effect sex change in parthonogenetic nematodes.

Approach: Develop and improve bioassays for detection of pheromones, utilize control release formulations, such as alginated pellets for application of pheromone and analogs to greenhouse and field, use in vitro tissue culture techniques to develop bioassays to test for sex change pheromones.

Progress: 89/10 to 89/12. A patent was completed, approved by the USDA Patent Committee and is in the process of being filed on the soybean cyst nematode sex pheromone and thirteen of its analogs. Greenhouse studies continued on the use of these compounds in alginated pellet formulations to reduce nematode populations with 6 out of 14 analogs completed. The use of these compounds may provide new environmentally safe compounds for commericial use to control soybean cyst nematodes. A study on the affect of root-knot nematodes on scion cultivars of peach propagated in vitro, the greenhouse and in microplots was completed. The results indicated that the response of peaches to nematodes at five weeks in vitro is the same as observed for in vitro propagated peaches grown in the greenhouse and under field conditions. The cultivar "Compact Red Haven" appeared to have the best level of nematode tolerance and will be tested in other locations. In vitro growth studies on Pastueria spp. continued. Monoclonal and polyclonal antibodies were developed in cooperation with Rutgers University. New cultivation techniques look very promising. Field plots were established in 1988 and 1989 in an area infested with soybean cyst nematodes that had been used to evaluate resistant soybean germplasm the previous season. A high degree of population spatial heterogeneity is desirable for developing computer models for

promotion of alternative control strategies and this was verified both years.

Publications: 89/10 to 89/12
HUETTEL, R.N. 1989. In vitro screening of soybean cultivars to Radopholus similis and R. citrophilus. Nematropica. In Press. Accepted June, 1989.
HUETTEL, R.N. 1898. Monoxenic culturing of plant parasitic nematodes. IN Plant Parasitic Nematodes. Lab Manual. U. MA Agr. Exp. Sta. Amherst, MA. In Press. Accepted May 1989.
HUETTEL, R.N., REISE, R.W. and HENN, A. 1989. A growers guide to plant parasitic nematodes in Maine. Extension Bulletin, University of Maine. In Press. Accepted June 1989.
HUETTEL, R.N. 1989. Aggregate formation in some Pratylenchus spp. Survival Mechanisms. J. Nematol. 21 566. Abstr.
HUETTEL, R.N. 1989. Response of peach scion cultivars and rootstocks to root-knot nematodes in vitro, in the greenhouse, and in microplots. J. Nematol. 21 566. Abstr.
FRANCL, L.J. and KENWORTHY, W.J. 1989. Heterogeneity in population density of soybean cyst nematodes after evaluation of soybean germplasm. J. Nematol. 21 561. Abstr.

67.026 0143396
NEMATODES FOR BIOCONTROL OF PEST INSECTS AND TAXONOMY OF INSECT PARASITIC NEMATODES

NICKLE W R; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-063-00D
Project Type: INHOUSE
Agency ID: ARS Period: 26 JUL 89 to 26 APR 90

Objectives: 1) Develop new and existing strains of the nematodes Steinernema and Heterorhabditis for the control/management of soil and foliar pest insects. 2) Develop new technologies for delivering and maintaining infective stage nematodes to control/manage soil and foliar insects. 3) To improve, modernize and stabilize the classification of the insect parasitic groups.

Approach: 1) Laboratory, greenhouse and field experiments with some of the 32 species and strains of the Steinernematid nematodes to control/manage insect pests such as the corn rootworm, Colorado potato beetle, and mushroom fly. 2) Water suspensions of nematodes will be used for mushroom flies. Anti- desiccants and UV blocks will be used on foliar insects and new pelletized formulations will be developed as delivery systems for pest soil insects. 3) To produce up to date taxonomic revisions of the important insect parasitic nematode groups.

Progress: 89/07 to 89/12. A taxonomic revision of the Aphelenchina, a large group of nematodes parasitic on plants, insects and fungi, was completed with Dr. David Hooper of the Rothamsted Experimental Station, England. The five Families and thirty-two genera were described and illustrated. Research was reported on control of the mushroom fly and an insect parasitic nematode. There was an 85% reduction of fly larvae when the nematodes were added at the rate of 620 nematodes per square centimeter. The highest control was achieved when the nematodes were added at the beginning of the third larval insect instar. Work will continue in a commercial mushroom house. Cooperative research with Dr. Connick, ARS New Orleans, on the development of a pelletized formulation as a delivery system for steinernematid nematodes to control pest soil insects was begun. A recent formulation showed that about 45% of the nematodes survived storage and were in healthy condition. The goals are to achieve a survival rate of 75% nematodes with this formulation. Research continues with Dr. W. W. Cantelo on spraying insect parasites nematode in an antidesiccant on foliage to control the Colorado potato beetle. This work is being carried out in a growth chamber and in small field plots.

Publications: 89/07 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

67.027* CRIS0049385
SYSTEMATICS, MORPHOLOGY, AND IDENTIFICATION OF CYST, ROOT-KNOT AND RELATED PLANT NEMATODES

GOLDEN A M; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.
Proj. No.: 1275-24000-048-00D
Project Type: INHOUSE
Agency ID: ARS Period: 30 APR 85 to 30 APR 90

Objectives: Develop new data and information on the systematics, morphology, and identification of important groups of plant nemataodes of the suborders Tylenchina and Dorylaimina with primary emphasis on cyst, root-knot and certain related forms; and further develop the taxonomic resources necessary for conducting this research.

Approach: Describe several new species in the selected nematode groups; clarify the Meloidogyne graminis species complex; develop new morphometric data and illustrations on certain root-knot and cyst forms; and synthesize a new or improved key and classification systems with predictive value for certain nematode groups. Curate and expand for taxonomic research and reference purposes the USDA Nematode Collection; and provide accurate identificationsof nematodes for various Federal and State agencies and scientists for research, regulatory, and control purposes.

Progress: 87/01 to 87/12. A new species of root-knot nematode on turfgrass in Maryland was found to be a species within the Meloidogyne graminis complex of species and was described; this provides a sound basis for testing turfgrasses for resistance to these individual species. Study of dagger nematodes, which transmit plant viruses and attack fruit and other economic crops, resulted in description of a new species, redescription of the American dagger nematode with elucidation of its variations, and clarification of relationships

of several other forms. These results provide means for accurate identification of these virus-vector nematodes which is critical for research and control purposes. Morphometric and photomicrographic data obtained on bacterial spore parasites observed on various kinds of nematodes indicated that several species of bacterial spore parasites are involved and are more host specific than thought. Previously these parasites, widely used in biocontrol research on nematodes, were viewed as one species with a wide host range. This will expedite biocontrol research by allowing workers to use single species rather than unknowingly, a complex of species. Nematodes from about 300 samples from various federal and state agencies and foreign countries were identified for research, regulatory and control purposes, revealing new species, hosts and occurrences. The USDA Nematode Collection now has 27,546 slides and vials with specimens.

Publications: 87/01 to 87/12

GOLDEN, A.M., MAQBOOL, M.A. and HANDO, Z.A. 1987. Descriptions of two new species of Tylenchorhynchus Cobb, 1913 (Nematoda:Tylenchida), with details on morphology and variation of T.claytoni. J. Nematol. 19:58-68.

JAFFEE, B.A., NYCZEPIR, A.P. and GOLDEN, A.M. 1987. Criconemella spp. in Pennsylvnaia peach orchards with morphological observatons on C. curvata and C. ornata. J. Nematol. 19:420-423.

JEPSON, S.B. and GOLDEN, A.M. 1987. Meloidogyne marylandi n.sp.(Nematoda: Meloidogynidae) a root-knot nematode parasitising grasses. C.A.B. International, Wallingford, Oxon, United Kingdom. Pp 263-265.

LAMBERTI, F. and GOLDEN, A.M. 1986. On the identity of Xiphinema americanum sensu lato in the nematode collection of Gerald Thorne with description of X. thornei sp.n. Nematol. medit 14:163-171.

SAYRE, R.M. and GOLDEN, A.M. 1987. Morpholgical differences of endospores among members of the Pasteuria penetrans group parasitizing nematodes. J. Nematol. 19: 555. (Abstr.).

WEHUNT, E.J. GOLDEN, A.M., WEAVER, C.F. and RODRIQUEZ-KABANA, R. 1987. First report of a Tylenchulus sp. on peach in Alabama, Arkansas, Georgia, and South Carolina. Ann. Appl. Nematol. 1: 127-128.

67.028 CRIS0049379

PLANT-PARASITIC NEMATODE CONTROL THROUGH NEW BIOREGULATION TECHNOLOGY

HUETTEL R N; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-040-00D
Project Type: INHOUSE
Agency ID: ARS Period: 30 APR 85 to 30 APR 90

Objectives: Develop basic understanding, basic control components, and basic managementprinciples for safer controlof nematodes through bioregulation; improved understanding of downward transport of systemic nematode bioregulators in plants; and develop new more effective controlled-release formulations technology.

Approach: Discover and develop natural and synthetic bioregulators from plants and animals for safer more effective nematode controls; basic research to demonstrate principles governing downward movement of nonphytotoxic sys- temic bioregulators that can affect nematodes in roots; controlled-release bioregulators; structure-activity studies.

Progress: 87/01 to 87/12. A new in vitro screening technique was developed to determine phytotoxicity of 29 analogs of the soybean cyst nematode sex pheromone to soybean cultivars. Two levels of each analog as well as the purified sex attractant and an isomer were tested. Insolubility was a problem with seven analogs, in that they would not dissolve in either acetone or ethanol. One analog caused the agar support medium to dissolve. Two analogs caused callus formation of the soybean root-explants. Suppressed root growth was observed at high levels of analogs in about 50% of the compounds tested. Nematodes were grown on the levels of analogs that did not cause root-growth problems. Low levels of the pheromone appeared to enhance nematode reproduction, with population levels higher than the controls. Some analogs appeared to interfere with juvenile hatching or host location. The use of analogs for soybean cyst nematode population control may provide new environmentally safe compounds for commercial use.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

67.029* CRIS0049448

PHEROMONES AND NATURAL BEHAVIOR MODIFYING CHEMICAL COMMUNICATORS OF HELMINTHS OF PLANTS

HUETTEL R N; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-028-00D
Project Type: INHOUSE
Agency ID: ARS Period: 01 OCT 84 to 30 SEP 89

Objectives: To study plant parasitic nematode behavior and observe, isolate and identify natural nematode metabolites and behavior modifying compounds (semiochemicals) that may be used to develop new, safer nematode control and bioregulation strategies.

Approach: Develop and improve xenic cultures of plant parasitic nematodes (particu- larly races of soybean cyst, Heterodera glycines; H. schachtii, sugarbeet cyst; H. zeae, corn cyst; Meloidogyne spp; root knot; Rotylenchulus reniformis, reniform; and Pratylenchus spp. lesion nematodes) to observe their development, behavior responses and reaction to pheromones and other semiochemicals. Develop and improve bioassay methods for the detection, isolation, purification and evaluation of specific pheromones and semio- chemicals. Usechromatographic (HPLC, TLC), electrophoretic

(SDS, isoelec- tric focusing), and histochemical techniques to isolate and purify new semiochemicals for chemicalcharacterization and to identify their synthesisand receptor sites. Compare similarities and differences of specific pheromones and metabolites of races and species cyst nematodes.

Progress: 87/01 to 87/12. A new in vitro screening technique was developed for determining the pathogenicity of migratory plant parasitic nematodes (PPN) to 15 soybean cultivars. Cultivars known to be resistant to cyst and root-knot nematodes (RN) were highly susceptible to PPN, burrowing nematode. Greenhouse and second year field studies of peach propagated from tissue culture show that the in vitro screening of peach to RN at five weeks gives the same results as two years in the field. The results of both these studies will be of value to breeders and researchers for developing new plant varieties. Digestion profiles of total DNA from three races of soybean cyst nematodes (SCN) by eight restriction enzymes were analyzed on agarose gels. The DNA fragment patterns generated by the three races appeared to be of diagnostic importance. A new technique for rapid DNA isolation was described. These studies aid in understanding the systematics of races of SCN and may lead to production of diagnostic kits for industry. Identification of the sex attractant of SCN has been verified by regrowth of SCN on root-explant in ultrapure water. Purification and identification was completed on GC-MS. The use of pheromones as bioregulators may provide industry with new approaches to nematode management.

Publications: 87/01 to 87/12

HUETTEL, R.N. 1987. In vitro screening of Radopholus citrophilus and R. similis to soybean cultivars. J. Nematol. 18:529. (Abstract)

HUETTEL, R.N., and JAFFE, H. 1987. Attraction and Behavior of Heterodera glycines, the soybean cyst nematode, to some biological and inorganic compounds. Proc. Helminthol. Soc. Wash. 54:122-125.

HUETTEL, R.N., and YAEGASHI, T. 1987. Morphological differences between Radopholus citrophilus and R. similis. Accepted by the J. Nematol. 9-15-87.

REISE, R.W., HUETTEL, R.N., and SAYRE, R.M. 1987. Carrot callus tissue for culture of endoparasitic nematodes. J. Nematol. 19:387-389.

KALINSKI, A., and HUETTEL, R.N. 1987. Repetitive fragments comparison as a diagnostic assay in detection of races of soybean cyst nematode, Heterodera glycines. Accepted by the J. Nematol. 12-20-87.

67.030* CRIS0140352

TAXONOMY OF IMPORTANT NEMATODE GENERA

NICKLE W R; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-047-00D

Project Type: INHOUSE

Agency ID: ARS Period: 31 JUL 85 to 31 JUL 90

Objectives: The objectives of this research ar to 1) improve, modernize and stabilize classification & identification of the genera Aphelenchoides, Ditylenchus, Anguina, & insect parasites by revising the groups with descriptions of newspecies, 2) redescribe the insect parasitic genus Bolbinium & review the genus Hexamermis, 3) develop a new computer data retrieval system to managetaxonomic names data, hosts & literature, & 4) study the effec of myco- phagus aphelenchs & ditylenchs on pathogenic fungi.

Approach: 1) Revise the genera Aphelenchoides, Ditylenchus, and Anguina and describe new species. 2) Redescribe the insect-parasitic genus Bolbinium from new specimens found in Florida. 3) Develop a new computer Telex Database II retrieval system to manage taxonomic names and literature. 4) Measure the effects of the mycophagus nematodes of the genera Aphelenchoides and Ditylenchus on the plant pathogenic fungi Rhizoctonia, Fusarium, and Verticillium in culture.

Progress: 87/01 to 87/12. The presence of pinewood nematode has been the cause of severe restrictions on the exportation of wood chips from the United States to the Scandinavian countries. This ban on the export of wood chip and lumber could result in the loss of million of dollars in export revenue. Taxonomic studie on the pinewood nematode were conducted to describe morphological differences between geographical races of this organisms. Using scanning electron micrographs morphometric studies were conducted to describe the organisms from France, Norway, and Minnesota. If these organisms can be shown to be the same species, the ban could be lifted. In cooperation with the U.S. Forest Service and industry representatives, a position paper on this problem was written. These findings and the paper should assist export of pinewood shavings from the U.S. Identifcations of nematodes were made as requested by agricultural scientists at a rate of about one sample every two weeks. From each sample a number of nematodes may be extracted. Permanen slides of insect nematodes were made and deposited in the USDA Nematode Collection.

Publications: 87/01 to 87/12

NO PUBLICATIONS REPORTED THIS PERIOD.

67.031* CRIS004945

INTERRELATIONSHIPS OF PLANT-PARASITIC NEMATODE AND THEIR NATURAL ENEMIES

SAYRE R M; Nematology Lab Plant Protection Inst; Beltsville Agr Res Center, Beltsville, **MARYLAND** 20705.

Proj. No.: 1275-24000-024-00D

Project Type: INHOUS

Agency ID: ARS Period: 15 APR 85 to 15 APR 9

Objectives: To isolate, catalog, and study soi microorganisms which aggressively attack plant-parasitic nematodes and to determine the edaphic factors influencing their survival and beneficial activities. In particular, to investigate separately and in combination the

interactions of antagonists with pest nematode populations and develop techniques and practices which permit their utilization as biocontrol agents (natural nematicides) in agricultural production systems.

Approach: Biocontrol agents isolated by appropriate sampling and laboratory techniques will be assayed for their nematicidal effectiveness and suitability for field applications. Their behavior or interrelationships (e.g. attrac-tion, penetration, and colonization of host nematodes) will be observed, recorded and analyzed. The role of environmental stress factors on nema- tode susceptibility to parasitism and on the mechanism governing the antagonist-nematode interactions will be investigated.

Progress: 87/01 to 87/12. Some species of soil fungi and bacteria that are natural enemies of plant-parasitic nematodes have been isolated and evaluated for their efficacy as potential biological control agents. The more promising agents were retained for developmental studies or for further biocontrol research. Strains that act as biocontrol agents in laboratory studies may eventually be used by growers to suppress nematode populations. A bioassay technique was developed for testing the potential of fungi to act as biocontrol agents of soybean cyst nematode. Stains were evaluated to determine which reliably distinguished eggs that had been killed by fungi from viable nematode eggs, and one of these stains was then used in the bioassay. Three fungi caused a statistically measureable decrease in the percentage of live eggs, and other fungi affected eggs to a lesser extent. Ten fungi exhibiting biocontrol potential were inoculated onto agar containing benomyl to determine the level of tolerance each fungus has to this fungicide. Cultivation of Pasteuria penetrans, a bacterium and a possible biocontrol agent of plant nematodes, was pursued through nutritional studies. A few of the experimental media appear to support modest growth of some of the bacterial isolates.. Electronmicroscopy studies of the fine structure of a Pasteuria species isolated from Heterodera glycines revealed a group of characteristics that distinguish this bacterium from others in its group.

Publications: 87/01 to 87/12

KRECEK, R.C., SAYRE, R.M., ELS, H.J., VAN NIERKIRK, J.P.and MALAN, F.S. 1987. Fine structure of a bacterial community associated with Cyanthostomes of zebras. J. Nematol. 19(4):537. (Abstract).

KRECEK, R.C., SAYRE, R.M., ELS, H.J., VAN NIERKIRK, J.P. and MALAN, F.S. 1987. Fine structure of a bacterial community associated with Cyanthostomes (Nematoda: Strongylidae) of zebras. Proc. Helmintho. Soc. Wash. 54(2):212-219.

MEYER, S.L.F. and SAYRE, R.M. 1987. Isolation and evaluation of selected fungal species potentially pathogenic on soybean cyst nematodes. J. Nematol. 19(4):543-544. (Abstract).

REISE, R.W., HUETTEL, R.N. and SAYRE, R.M. 1987. Use of carrot callus tissue in culturing endoparasitic nematodes. J. Nematol. 19(3):387-389.

SAYRE, R.M. and GOLDEN, A.M. 1987. Morphological differences of endospore among members of the Pasteuria penetrans group parasitizing nematodes. J. Nematol. 19(4):555. (Abstract).

SAYRE, R.M., WERGIN, W.P., ENDO, B.Y., and STARR, M.P. 1987. Ultrastrcture comparison of Pasteuria penetrans a bacterial parasite of Meloidogyne incognita and a related parasite of Pratylenchus brachyurus. J. Nematol. 19(4):555-556. Abst.

67.032 CRIS0094920

INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

KRUSBERG L R; HUTZELL P A; HASHMI S; Botany; University of Maryland, College Park, **MARYLAND** 20742.

Proj. No.: MD-J-129 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Determine the relationships among nematode population densities and crop yields, and the impact of biotic and abiotic stress factors on these relationships. Using the principles of IPM, develop integrated nematode management programs designed to minimize crop yield losses, environmental contamination, and human health risks.

Approach: Corn cyst nematode Heterodera zeae. Fumigants applied in naturally infested fields will be used to measure nematode pathogenicity. Microplots with different soil types and different nematode inoculum levels will be used to study nematode pathogenicity, influence of fertility on pathogenicity, nematode reproduction, influence of soil types on the nematode and plant, and survival of the nematode. Growth chambers will be used to study interactive effects of temperature, soil type, fertility levels and soil moisture levels on pathogenicity and biology of the nematode. Soybean cyst nematode H. glycines. Naturally infested field plots will be used to study nematicide efficacy and to evaluate soybean entries for resistance and agronomic characteristics.

Progress: 87/01 to 87/12. Corn cyst nematode (CCN) Heterodera zeae in 1987 field microplot studies suppressed yield of Pioneer 3184 corn growing in sandy soil by 17% in the presence of fertilizer, but by 56% in the absence of fertilizer. In sandy soil addition of fertilizer resulted in a yield increase of 61% in the presence of CCN and 27% in the absence of CCN. In silt soil CCN suppressed corn yield by 12% in the presence of fertilizer and by 19% in the absence of fertilizer. In silt soil addition of fertilizer resulted in a yield increase of 23% in the presence of CCN and 17% in the absence of CCN. Corn growing in silt soil yielded 13-24% more than in sandy soil. Sixteen months after beginning the study sandy soil contained 15% more total cysts, but only about 18% as many second-stage juveniles (J2),

than did silt soil. In a field microplot host plant study 16 months after beginning the test cysts and J2 of CCN were abundant only in plots planted to corn and fall panicum, and J2 were abundant in a microplot with common reed. It appeared that there was little or no reproduction of CCN in plots planted to Kentucky bluegrass, perennial ryegrass, K31 fescue, sorghum, or sugarcane. In the third year of a long-term study of the population dynamics of CCN in naturally infested corn fields large numbers of free J2 but few cysts are being found in soil samples, which is the same as was found in the first two years.

Publications: 87/01 to 87/12

RINGER, C.E., SARDANELLI, S. and KRUSBERG, L.R. 1987. Investigations of the host range of the corn cyst nematode, Heterodera zeae, from Maryland. Annals of Applied Nematology 1:97-106.

67.033 0139473

INTERACTION OF NEMATODE-HOST VARIABILITY AND ABIOTIC FACTORS ON CROP LOSS

POWERS T O; WYSONG D S; KERR E D; Plant Pathology; University of Nebraska, Lincoln, **NEBRASKA** 68583.

Proj. No.: NEB-21-039 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 88 to 30 SEP 93

Objectives: 1. Determine the intraspecific variability of plant-parasitic nematodes. 2. Determine the variability in nematode-host interactions. 3. Determine the relationships among host, abiotic factors, and crop losses caused by plant-parasitic nematodes.

Approach: We will examine DNA variation within and among plant parasitic nematode populations. Approaches include DNA hybridization, nucleotide sequencing, polymerase chain reaction, and restriction mapping.

Progress: 89/01 to 89/12. In our analyses of genetic variability among populations of plant parasitic nematodes, we have focused on two groups of nematodes, the cyst species, Heterodera, and the root-knot nematodes, Meloidogyne. In Meloidogyne we have demonstrated that there is a strong correlation between mitochondrial genotype and species designation. This has led to the development of a diganostic protocol based on the new technique of polymerase chain reaction (PCR). This protocol permits the identification of Meloidogyne species from a single juvenile or egg. An advantage of the technique is that it requires no DNA purification or radioisotopes. To date we have tested the protocol on over 20 populations of Meloidogyne. We are now initiating experiments to use these probes to evaluate changes in species composition in field populations following different cropping systems. We have also examined the mitochondrial variability in over 30 populations of Heterodera glycines, the soybean cyst nematode, and 10 populations of H. schachtii, the sugar beet cyst nematode. Both of these species appear to be characterized by a population structure that indicates high rates of gene flow among populations and the frequent founding of new populations by a limited number of cysts.

Publications: 89/01 to 89/12

POWERS, T.O., SANDALL, L.J., and WYSONG, D.S. 1989. Distribution of soybean cyst nematode in Nebraska. Ann. of Appl. Nematol. 4S 612-614.
HARRIS, T.S., SANDALL, L.J., and POWERS, T.O. 1990. Identification of single Meloidogyne juveniles by polymerase chain reaction. J. Nematol. (Accepted for publication).
HARRIS, T.S., SANDALL, L.J., and POWERS, T.O. 1989. Enhanced molecular diagnostics using polymerase chain reaction. J. Nematol. 21 564. (Abstr.).
POWERS, T.O., and SANDALL, L.J. 1989. Mitochondrial DNA and species boundries in Meloidogyne. J. Nematol. 21 581. (Abstr.).
SANDALL, L.J., and POWERS, T.O. 1989. Evidence for rapid and widespread dispersal of the soybean cyst nematode. J. Nematol. 21 585. (Abstr.).

67.034* CRIS0142036

PURIFICATION AND STRUCTURAL DETERMINATION OF THE GOLDEN NEMATODE HATCHING FACTOR I

BRODIE B B; RIOPEL J L; HECHT S; Agricultural Research Service, Ithaca, **NEW YORK** 14853.

Proj. No.: 1907-22240-001-03R
Project Type: INHOUSE
Agency ID: ARS Period: 01 MAR 87 to 28 FEB 89

Objectives: Purify and structurally analyze the natural golden nematode hatching factorfrom potato root diffusate.

Approach: From previously designed procedures using column chromatography the golden nematode hatching factor will be isolated from potato root diffusate. UsingHPLC the factor will be purified in sufficient quantities for structural determination. Reimbursable with APHIS - PPQ.

Progress: 87/01 to 87/12. Over the past year an isolation protocol was developed that resulted in the successful isolation of 10 micrograms of the golden nematode hatching stimulant. This amount proved insufficient for structural determination. However, the following analyses of the active factor were performed. 1) NMR - Four hour pulse yielded no usable data because of small amount of compound. 2) U.V. - spectra revealed no absorbance at wavelengths higher than 220 nm, suggesting that the compound is not aromatic or highly conjugated. 3) Mass Spectroscopy - the compound did not ionize well using electron impact mass spectroscopy, suggesting that part of the compound is very polar. It was concluded that structural determination will require a significantly greater amount of the active factor. Work is in progress to maximize the amount of active factor collected from potato root exudate and to enhance the efficiency of the isolation scheme. To that end, only young plants are being used for root exudate collections and the isolation protocol has been improved.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

67.035 CRIS0083045
INTEGRATED MANAGEMENT OF PLANT PARASITIC NEMATODES

KO M P; HARRISON M B; Plant Pathology; Cornell University, Ithaca, **NEW YORK** 14853.
Proj. No.: NYC-153449 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Determine the relationships among initial nematode population densities and crop yields, and the impact of biotic and abiotic stresses on these relationships. Develop improved nematode sampling methodology and assay procedures for IPM programs.

Approach: Assess and characterize the changes that occur in a population of Xiphimema americanum as related to time of year, soil temperature and soil moisture. Stage of life cycle and three critical measurements will be recorded. The same procedure using the same standardized methods will be used in a coordinated study in Pennsylvania with populations of X. americanum and X. rivesi. This work is carried out in microplots. Test green manure crops other than oats for thier effect on build-up of P. pentrans, their effect on the severrity of damage to growth and yield by non-parasitic rhizospher organisms. Their effect on virulence of P. penetrans. Identify biological control agents and test ways to increase their effectiveness in reducing P. penetrans populations and increasing growth and yield. Test the effect of isolates of Pseudomonas sp. on growth reduction of apple caused by P. penetrans.

Progress: 87/01 to 87/12. Cover crops were evaluated for control of apple replant disease (ARD) (Ian Merwin, M.S. Thesis, 1987, Cornell University). 'Saia' oats and 'Sparky' marigolds were found to suppress ARD using the apple seedling bioassays in the growth chamber. Experiments are now initiated to study the mode(s) of action of marigold under sterile and field conditions and eventually its efficacy in the field. Inoculation of Pratylenchus penetrans in root explants of marigold indicated that the nematodes were attracted to the roots, but only a few of them penetrated, and even fewer eventually developed and reproduced inside the plant tissue. The fates of these nematodes are being examined. Research to develop systems for selecting alfalfa (Medicago sativa) resistant to P. penetrans has shown that root fresh weight is the plant character most highly correlated (negatively) with number of nematodes per gram of roots. Concentration of nematodes in the root (number of nematodes per gram of root) had more effect on top growth than did number of nematodes per plant. Root and total fresh weights of clones were positively correlated with number of nematodes per plant, showing that different root systems of clones elicit different responses to nematode infection. These correlation coefficients generally were small in magnitude. Selection for root weight and a selection index based on root weight and/or top weight and nematodes per gram of root may be effective for indirect selection of resistant plants.

Publications: 87/01 to 87/12
DA FONSECA, C.E. 1987. Development of a method for breeding alfalfa with resistance to the root lesion nematode. Ph.D. Dissertation, Cornell University, Ithaca, NY.
JAFFEE, B.A., HARRISON, M.B., SHAFFER, R.L. and STRANG, M.B. 1987. Seasonal population fluctuation of Xiphinema americanum and X. rivesi in New York and Pennsylvania orchards. J. Nematol. 19:369-387.
WAKED, M.Y. and HARRISON, M.B. 1986. Histopathological studies on grape roots infected with Meloidoderita sp. Comm. in Sci. & Dev. Res. 16:47-60.

67.036 CRIS0094240
CROP NEMATODE RESEARCH AND CONTROL PROJECT

SASSER J N; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.
Proj. No.: NC05580 Project Type: STATE
Agency ID: SAES Period: 15 SEP 84 to 31 DEC 89

Objectives: Develop and make available to large areas of the world cultivars of crops resistant to root-knot nematodes, provide developing country growers with optimum crop rotation/management sequences for controlling crop losses due to plant-parasitic nematodes, quantify the relationship of nematode numbers to crop yield for a variety of crops and plant-parasitic nematodes of worldwide importance, demonstrate the feasibility of optimizing cropping systems for developing country growers through an international cooperative research effort, and facilitate development of quality nematology services in developing countries, increase communication and transfer nematode management information to growers through extension publications.

Approach: The various international agriculture research centers will provide germ plasm of mandate crops for screening for resistance to root-knot nematodes. Cropping systems research will be initiated in selected developing countries in collaboration with cooperators of the CNRCP. Increased communication will be accomplished through a newsletter, regional conferences and workshops. Technology transfer of management information to growers will be through extension publications.

Progress: 84/09 to 87/12. Crop germplasm from six international agricultural centers was screened for resistance to four major species of root-knot nematodes, Meloidogyne species; 1830 breeding lines of bean, desmodium, barley, corn, wheat, triticale, chickpea, peanut, pigeon pea, rice, sweet potato, and potato were evaluated. Cooperative research on cropping systems for the control of plant-parasitic nematodes was conducted in Peru, the Philippines, Cyprus, Brazil, Chile, Sri Lanka, and North Carolina (USA). Nematode damage

functions and reproductive curves have been determined for each of the following crop/nematode combinations, with compensation for differences in soil structure and fertility among the plots: Hoplolaimus columbus on cotton, corn, and soybean; and Meloidogyne hapla on peanut, corn and soybean. Mini-workshops on cropping systems research were offered at meetings of four major international societies. Thirty scientists from 20 developing countries received short-term instruction at North Caolina State University. A three-week international course in plant nematology was offered June 2-20, 1986, and a one-week workshop held Sept 14-18, 1987, emphasized screening for resistance. A quarterly international newsletter was established in which abstracts of research from developing-country scientists could be published.

Publications: 84/09 to 87/12

CARTER, C. C. 1987. Writing agricultural information bulletins - reaching developing-country farmers. Crop Nematode Research & Control Project, NCSU, Raleigh, NC. 10 p.

CARTER, C. C. (ed.). 1987. Int. Nematol. Network Newsletter 4(1-4).

SAKA, V. W., and CARTER, C. C. 1987. Hosts and nonhosts of the root-knot nematode Meloidogyne incognita. Crop Nematode Research & Control Project, NCSU, Raleigh, NC. 62 p.

SASSER, J. N., and FRECKMAN, D. W. 1987. World perspective on nematology: the role of the society, p. 7-14 IN Vistas on nematology. Soc. Nematol., Hyattsville, MD 509 p.

SASSER, J. N., HARTMAN, K. M. and CARTER, C. C. 1987. Summary of preliminary crop germplasm evaluations for resistance to root-knot nematodes. Crop Nematode Research & Control Project, NCSU, Raleigh, NC. 87 p.

67.037* CRIS0133441
MODELLING INTERACTIONS BETWEEN PLANTS AND PESTS

SCHNEIDER S M; Plant Pathology; North Carolina State University, Raleigh, **NORTH CAROLINA** 27695.

Proj. No.: NC05638 Project Type: STATE
Agency ID: SAES Period: 01 OCT 86 to 30 SEP 91

Objectives: Develop computer models describing the dynamic, physiological interaction between plants and pests such as nematodes, viruses, fungi, bacteria, insects, and weeds. Develop techniques to measure the goodness-of-fit of the models.

Approach: Obtain or develop physiological process oriented plant models. Obtain or develop pest population models. In cooperation with other scientists, determine the impact of the pest on the physiology of the plant and the influence of the host plant on the development of the pest. Describe the interaction between plant and pest quantitatively. Use mathematical descriptions to dynamically link the plant model and pest model.

Progress: 87/01 to 87/12. The dynamic modelling of plant/pest interactions requires plant and pest models and a model of the interaction between the two. Field data was collected for development and validation of a tobacco growth model. Weekly measurements of NC2326 and K399 included leaf length, width, surface area, fresh and dry weight, alkaloid, sugar, starch, and nitrogen concentrations. Environmental variables include air and soil temperature, rainfall/irrigation, and solar radiation. Work on the rootknot nematode/tobacco interaction has concentrated on penetration and development of two rootknot nematode species on two commercial tobacco varieties. NC2326 is susceptible to Meloidogyne incognita (Mi), Meloidogyne arenaria (Ma), and Meloidogyne javanica (Mj). K399 was bred for resistance to Mi. Results showed that numbers of Mi and Ma observed in the roots of NC2326 steadily increased from days 1 to 14 after inoculation. Numbers of Mj observed in the NC2326 were not consistent. Numbers of Mi and Ma in K399, were greater than those in NC2326 at 4 days, but by 14 days the numbers of Mi and Ma were 54% and 71% less than those found in NC2326. Final populations of Mj were similar in the NC2326 and K399. These results indicate that K399 has some resistance to Ma and that the nematode is capable of penetrating the resistant variety, but leaves the root when a functional feeding site cannot be established.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

67.038* CRIS0047580
BASIC NEMATOLOGY RESEARCH

VEECH J A; Agricultural Research Service; Agricultural Research Service, College Station, **TEXAS** 77843.

Proj. No.: 6202-20270-002-00D
Project Type: INHOUSE
Agency ID: ARS Period: 05 APR 82 to 17 FEB 87

Objectives: Determine the basic biochemical and physiological mechanisms by which nematodes parasitize plants and plants resist parasitism by nematodes, the ultimate goal of which is to develop improved nematode/control technologies based on such knowledge.

Approach: Physiological and biochemical techniques will be employed to elucidate the nutritional requirements, reproduction chemistry, and mechanisms of parasitism of plant parasitic nematodes. The effects on plant parasitic nematodes of constitutive and induced plant products will be investigated by bioassay and biochemical procedures. Metabolic inhibitors, labeled intermediates, and specific biochemical procedures will be used for comparative studies of nematode infected susceptible, tolerant, and resistant plants. Allelopathic relationships of plants and nematodes will be elucidated.

Progress: 86/01 to 86/12. Stylet exudate collected from adult female Meloidogyne incognita excised from host roots was assayed for its effect on plant cells maintained in

liquid culture. A video camera was linked to an interference contrast microscope, and we were unable to observe an effect of topical application of stylet exudate on host cells. Conditions for micro-injection of stylet exudate into recipient host cells for subsequent VCR monitoring are now being worked out. Previously, antibodies to stylet exudate were produced in healthy white mice subsequently inoculated with a specific tumor cell line. Instead of collecting blood from the mice, tumor fluid is collected; tumor fluid volume is about 20 times the volume of collectable blood, and gives a corresponding increase in yield of the desired antibodies.

Publications: 86/01 to 86/12

STARR, J.L. and VEECH, J.A. 1986. Root-knot nematode susceptibility of cotton putatively resistant to Fusarium wilt-root knot nematode complex. Crop Sci. 23:543-546.

67.039 CRIS0065795

QUANTIFYING THE NEMATODE PEST MANAGEMENT DECISION PROCESS

GRIFFIN G D; CHATTERTON N J; Plant Science; Utah State University, Logan, **UTAH** 84322.
Proj. No.: UTA00582 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 84 to 30 SEP 89

Objectives: Refine and optimize sampling and extraction methodologies for nematode detection and assessment. Determine the relationship between crop losses and nematodes as affected by environmental conditions. Determine cost/efficacy functions to allow for deviation of economic thresholds.

Approach: Identify effects of time of sampling, soil depth, soil types, distribution patterns, and soil moisture on nematode population dynamics. Determine, through experimental field and greenhouse studies, the effect of different nematode species and populations on economically important plants under different environmental regimes. Determine cost/benefits of the effect of nematode population densities under different control strategies.

Progress: 87/01 to 87/12. Nematode resistant alfalfa, Nevada Synthetic XX, differed in its response and degree of resistance to Meloidogyne hapla populations from California, Utah, Washington, and Wyoming, and was 100% susceptible to one California population; Ranger alfalfa was 100% susceptible to all populations. Species of Astragalus, Coronilla, Hedysarum, Lathyrus, Lotus, Medicago, Melilotus, Dnobrychis, Trifolium, and Vicia differed in susceptibility and nitrogen fixation to Meloidogyne hapla and M. chitwoodi populations. Population densities of Merlinius brevidens, Quinisulcius acutoides, and Pratylenchus neglectus are greater under continuous no-till and chemical fallow no-till regimentations than other conventional fallow cultivation of wheat. The susceptibility of resistant Apollo II and Nevada Synthetic XX, and susceptible Ranger alfalfas to combined inoculations of M. hapla and Phytophthora megasperma f. sp. medicaginis was greatest at 28 C. There was a direct relationship between M. hapla and M. chitwoodi population densities and the growth of Lahontan alfalfa, Hycrest wheatgrass, and Russian wildrye in a competitive plant study; increased nematode population densities reduced plant growth of both resistant and susceptible plants.

Publications: 87/01 to 87/12

GRIFFIN, G.D. 1987. The importance of environmental factors and cultural M practices on parasitism of alfalfa by Ditylenchus dipsaci. J. Nematol. 19:267-276.
GRIFFIN, G.D. 1987. The interaction of Ditylenchus dipsaci and Meloidogyne hapla on susceptible and resistant plants. J. Nematol. 19:441-446.
GRIFFIN, G.D. 1987. Efficacy of using split and post-plant applications of aldicarb to control Heterodera schachtii on sugarbeet. Ann. Applied Nematol. 1:119-122.
GRIFFIN, G.D. 1987. Nonvolatile nematicide control of Heterodera schachtii on sugarbeet. J. Am. Soc. Sugarbeet Tech. (accepted).
EISENBACK, J.D. and GRIFFIN, G.D. 1987. Interactions with other nematodes, pp. 313-320. In: VEECH, J.A. and DICKSDN, D.W. (eds.) Vistas on Nematology. Hyattsville, MD. Soc. of Nematologists, Inc.
GRIFFIN, G.D. and THYR, B.C. 1987. Interaction of Meloidogyne hapla and Fusarium oxysporum f. sp. medicaginis on alfalfa. Phytopathology (accepted).
GRIFFIN, G.D. 1987. Factors affecting the biology and pathogenicity of Heterodera schachtii on sugarbeet. J. Nematol. (accepted).
GRIFFIN, G.D. 1987. Comparative nematicidal control of Heterodera schachtii on sugarbeet as affected by soil temperature and soil type. Plant Disease (accepted).

67.040 0139663

DESIGN AND EVALUATION OF NEW APPROACHES FOR THE MANAGEMENT OF PLANT-PARASITIC NEMATODES

CDSTANTE J F; Plant & Soil Sciences; University of Vermont, Burlington, **VERMONT** 05405.
Proj. No.: VT-PS-00460 Project Type: HATCH
Agency ID: CSRS Period: 01 OCT 89 to 30 SEP 94

Objectives: Determine the basic biology of nematode-host relationships and associated microbial interactions necessary for the development of improved nematode control methods; and develop improved management tactics for plant parasitic nematodes emphasizing biological and cultural control procedures.

Approach: Dngoing, long-term apple replant disease (ARD) experiments, initiated at the DVM Orchard in 1984 and 1988 will continue to evaluate ARD control and suppression strategies involving nematicides, fertilizers, green manure crops (including marigolds) and irrigation as alternatives to conventional pesticides. Proper resources are present for

carrying out the field and laboratory work required.

Progress: 89/01 to 89/12. Project began on October 1, 1989.

Publications: 89/01 to 89/12
NO PUBLICATIONS REPORTED THIS PERIOD.

67.041* CRIS0142037
PURIFICATION AND STRUCTURAL DETERMINATION OF THE GOLDEN NEMATODE HATCHING FACTOR II

BRODIE B B; RIOPEL J L; HECHT S; University of Virginia, Charlottesville, **VIRGINIA** 22903.
Proj. No.: 1907-22240-001-04C Project Type: CONTRACT
Agency ID: ARS Period: 01 MAR 87 to 28 FEB 89

Objectives: Purify and structurally analyze the natural golden nematode hatching factor from potato root diffusate.

Approach: From previously designed procedures using column chromatography the golden nematode hatching factor will be isolated from potato root diffu- sate. Using HPLC the factor will be purified in sufficient quantities for structural determination.

Progress: 87/01 to 87/12. Over the past year an isolation protocol was developed that resulted in the successful isolation of 10 micrograms of the golden nematode hatching stimulant. This amount proved insufficient for structural determination. However, the following analyses of the active factor were performed. 1) NMR - Four hour pulse yielded no usable data because of small amount of compound. 2) U.V. - spectra revealed no absorbance at wavelengths higher than 220 nm, suggesting that the compound is not aromatic or highly conjugated. 3) Mass Spectroscopy - the compound did not ionize well using electron impact mass spectroscopy, suggesting that part of the compound is very polar. It was concluded that structural determination will require a significantly greater amount of the active factor. Work is in progress to maximize the amount of active factor collected from potato root exudate and to enhance the efficiency of the isolation scheme. To that end, only young plants are being used for root exudate collections and the isolation protocol has been improved.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

67.042 CRIS0029258
PATHOGENICITY OF PLANT PARASITIC NEMATODES ASSOCIATED WITH IRRIGATED AGRICULTURE IN WASHINGTON

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP01491 Project Type: STATE
Agency ID: SAES Period: 01 JUL 87 to 30 JUN 90

Objectives: Evaluate nematode-host associations where nematode pathogenicity has not been demonstrated; conduct nematode surveys on crops lacking such information; and discover new nematodes attacking crops in WA.

Approach: Pathogenecity, biology, host range, interaction, & ecological studies will be conducted under controlled greenhouse conditions. Pure populations of nematodes from lab or greenhouse cultures will be used to measure the effects of suspected pathogens on host plants. Test soils will be free of other pathogens before use. Experiments will be arranged on greenhouse benches and/or in temp-controlled water tanks in randomized block designs. Data collected includes measurements of plant growth, dry weight accum., nematode population development, & symptom expression. When desirable, tests will be extended to the field were tests will be conducted in microplots. To evaluate nematode control, fields naturally infested with the nematode pathogen will be selected. Comparison of nematicide treated & nontreated replicated plots will be made in terms of nematode control, plant growth, yield and/or quality. Microplots will be used to evaluate crop rotation and/or fallow sequences to control nematodes.

Progress: 87/01 to 87/12. Nemacur was evaluated for control of Pratylenchus penetrans on nonbearing and 3-yr-old Granny Smith apples on MM7a rootstock. Nemacur was also evaluated for control of Meicycliophora spp. on apples. No difference in growth were observed among the treatments in any of the trials this first year. Mocap, Nemacur, and Vydate were evaluated for control of nematodes on Scotch spearmint and peppermint under sprinkler and furrow irrigation. No significant increases in hay or oil were found among the treatments. On the contrary, several treatments produced less oil than the nontreated plots. Studies on the interrelationship between Pratylenchus penetrans, Meloidogyne hapla, and Verticillium dahliae show that the nematodes in presence of the fungus were able to increase the incidence and severity of Verticillium wilt on Scotch spearmint.

Publications: 87/01 to 87/12
NO PUBLICATIONS REPORTED THIS PERIOD.

67.043 CRIS0094252
PATHOGENICITY OF PLANT PARASITIC NEMATODES ASSOCIATED WITH IRRIGATED AGRICULTURE IN WASHINGTON

SANTO G S; Plant Pathology; Washington State University, Prosser, **WASHINGTON** 99350.
Proj. No.: WNP01491 Project Type: HATCH
Agency ID: CSRS Period: 10 AUG 84 to 30 JUN 87

Objectives: Evaluate nematode-host associations in which nematode pathogenicity has not been demonstrated; Conduct nematode surveys on crop plants lacking such information, and Oiscover new nematodes attacking crops in Washington.

Approach: Pathogencity, biology, host range, interaction, & ecological studies will be conducted under controlled greenhouse conditions. Pure populations of nematodes from lab or greenhouse cultures will be used to measure effects of suspected pathogens on host plants. Soil used in tests will be free of other pathogens before use. Each experiment will be arranged on greenhouse benches and/or in temperature-controlle d water tanks in randomized block designs w/5 or more replicates. When experiment is completed, experimental data to be collected will include measurements of plant growth, dry weight accumulation, nematode population development, & symptom expression. When desirable, experimentation will be extended to the field. Field tests will be conducted in microplots. To evaluate nematode control, fields naturally infested w/the nematode pathogen will be selected for study.

Progress: 87/01 to 87/06. Field and greenhouse indicate that Meloidogyne hapla, Xiphinema pactaicum, and Crisonemella xenoplas are of economic importance on grapes in Washington. Nematicide trials show that Furaden, Nemacur, and Temik increased Concord grape yields an average of 24%. This amounts to an annual estimated loss of $3-4 million. Field and greenhouse studies indicate that Pratylenchus penetrans is of economic importance on apples in Washington. Of the nematicides evaluated Nemacur, Temik, and Vydate has given a consistent increase in plant growth and yields. Studies with P. neglectus indicates that this species may not be important on apples. Biology and control studies show that the root-knot nematodes, especially Meloidogyne chitwoodi is a serious pest on potatoes. M. chitwoodi infects tubers earlier and more severely than M. hapla. Soil fumigation is the most common means to control these nematodes. However, under suboptimal fumigation conditions and/or high M. chitwoodi populations the best treatment has been the combination of a soil fumigant and Mocap. This project has also examined the importance of nemstodes on crops including sugarbeets, corn, peas, beans, alfalfa and mint.

Publications: 87/01 to 87/06
NO PUBLICATIONS REPORTED THIS PERIOD.

KEYWORD/TITLE INDEX

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ABSCISIC-ACID
PHYSIOLOGICAL INDICATORS OF STRESS IN PEACH TREES AFFECTED BY PEACH TREE SHORT LIFE. **10.046**
ABUTILON-THEOPHRASTI
AUTECOLOGY AND CONTROL OF SOILBORNE PLANT PATHOGENS. **23.036, 28.004***
ACETYLCHOLINE
NEURONAL CONTROL MECHANISMS IN NEMATODES. **65.049**
ACETYLCHOLINESTERASE
CONTROL AND REGULATORY MECHANISMS IN PLANT-PARASITIC NEMATODES. **23.081, 65.048***
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SUPPRESSION OF AFLATOXIN AND NEMATODES IN CORN THROUGH CULTURAL PRACTICES. **14.045**
AGROBACTERIUM
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